MODIFIED SELVESTER QRS SCORE IN PREDICTING SUCCESSFUL ST SEGMENT RESOLUTION IN PATIENTS WITH ACUTE MYOCARDIAL INFARCTION RECEIVING FIBRINOLYTIC THERAPY WITH STREPTOKINASE

DISSERTATION SUBMITTED FOR

DOCTOR OF MEDICINE

BRANCH - I (GENERAL MEDICINE)

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CHENNAI

BONAFIDE CERTIFICATE

This is to certify that the dissertation entitled **"MODIFIED SELVESTER QRS SCORE IN PREDICTING SUCCESSFUL ST SEGMENT RESOLUTION IN PATIENTS WITH ACUTE MYOCARDIAL INFARCTION RECEIVING FIBRINOLYTIC THERAPY WITH STREPTOKINASE"** submitted by **Dr. K.RAMYA** to the Tamil Nadu Dr. M.G.R. Medical University, Chennai in partial fulfillment of the requirement for the award of M.D Degree Branch–I (General Medicine) is a bonafide research work were carried out by her under my direct supervision & guidance.

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DECLARATION

I, **Dr.K. RAMYA** declare that, I carried out this work on, "**MODIFIED SELVESTER QRS SCORE IN PREDICTING SUCCESSFUL ST SEGMENT RESOLUTION IN PATIENTS WITH ACUTE MYOCARDIAL INFARCTION RECEIVING FIBRINOLYTIC THERAPY WITH STREPTOKINASE**" at the Department of Medicine, Govt. Rajaji Hospital during the period of March 2012 to August 2012. I also declare that this bonafide work or a part of this work was not submitted by me or any others for any award, degree, diploma to any other University, Board either in India or abroad.

This is submitted to The Tamilnadu Dr. M. G. R. Medical University, Chennai in partial fulfillment of the rules and regulations for the M.D degree examination in General Medicine.

Place : Madurai **Dr.K. RAMYA**

Date :

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CONTENTS

INTRODUCTION

Coronary artery disease, the number one killer in the world, is a disease of the heart where the coronary arteries are either partially occluded resulting in myocardial ischemia, or totally occluded resulting in myocardial infarction (MI). MI could be a minor event, perhaps not even recognized, or it may be a major attack with results varying from acute pain, hemodynamic deterioration to sudden death. The early detection of an infarction greatly improves the patients' chances of survival and return to health and is therefore very important.

The real incidence of acute myocardial infarction is difficult to judge because of varied reporting pattern. Moreover increased incidence of diabetes and obesity, stemming from global shift to western diet and lifestyle will increase consequent coronary artery disease in the near future.

Death due to silent ischaemia is common especially in diabetics and elderly and it's the common cause of sudden death outside the hospital

The mortality rate of patients with presumed myocardial infarction or acute coronary syndrome in the first month is ~50% and of these deaths about half occur within the first 2 hrs. For the first six months after

infarction, the risk of developing sudden death is still high, but this risk falls after this period. Anterior infarction carries a grave prognosis if accompanied by conduction disturbances. All the major complications worsen the prognosis. Age above 70 years, hypertension, diabetes and heavy cigarette smoking worsen the outlook further.

Patients requiring cardiopulmonary resuscitation during the course of the illness run a higher risk of fatal arrhythmias in the first few years after discharge from hospital. Evidence is that atleast a small proportion of cardiac myocytes compensate to make up for the lost cells, on long term follow up. The high initial mortality of MI has decreased with the advent of coronary care unit, fibrinolytic therapy and catheter based reperfusion. Although primary percutaneous coronary intervention (PCI) has been shown to decrease mortality, a significant number of patients with acute MI are not eligible for this as they cannot reach hospitals within the required time window. As the elderly constitute an increasing proportion of those presenting with acute MI having high mortality, but is not eligible for fibrinolytic therapy, MI may continue to remain the leading cause of death over the next several decades.

Myocardial infarction may be revealed by any of the following - clinical symptoms and signs, biochemical markers, imaging or pathological characteristics, but the most important initial clinical test for diagnosis of MI remains electrocardiography. The relative ease of use, low cost and particularly the non-invasiveness and speed makes it an excellent tool for a patient with suspicion of MI.

REVIEW OF LITERATURE

Currently, India is going through a phase of epidemiological transition, where there is a shift in the cause of mortality from communicable diseases to non-communicable diseases, particularly Cardiovascular disease (CVD). It affects Indian population earlier and denies many youngsters of their most productive life years. Researchers in India and international agencies like World Health Organization , found a steady increase in the burden of cardiovascular disease over the past 15 years.

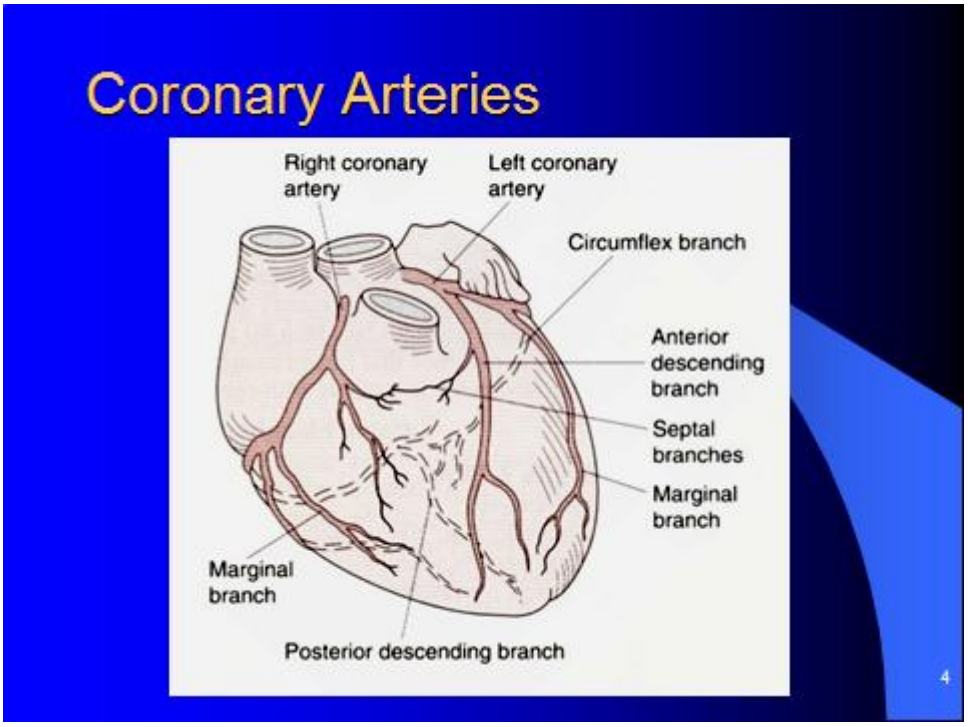
The disease is more prevalent in the urban population and has a clear variation in prevalence from rural to semi-urban population. In the Indian scenario, it has been predicted that by the year 2020, there will be an increase by almost 75% in the cardiovascular disease burden[3].

Urban India	1960	1%
	1995	8 – 10%
Rural India	1974	2%
	1995	4%

In the last 5 decades in urban India, coronary artery disease (CAD) has increased more than 6 fold and the current prevalence rate of CAD is 10% in the 35 to 65 years age group. The prevalence has almost doubled in the rural areas too over the few decades . CVD has thus begun to outrank infectious diseases in causing death. In India the peak period of occurrence of MI is seen to be between 51-60 yrs i.e. it appears a decade earlier in India as compared to the developed countries.

ANATOMY OF CORONARY

ARTERIES



Coronary arteries arise from coronary sinuses at the base of the aorta.

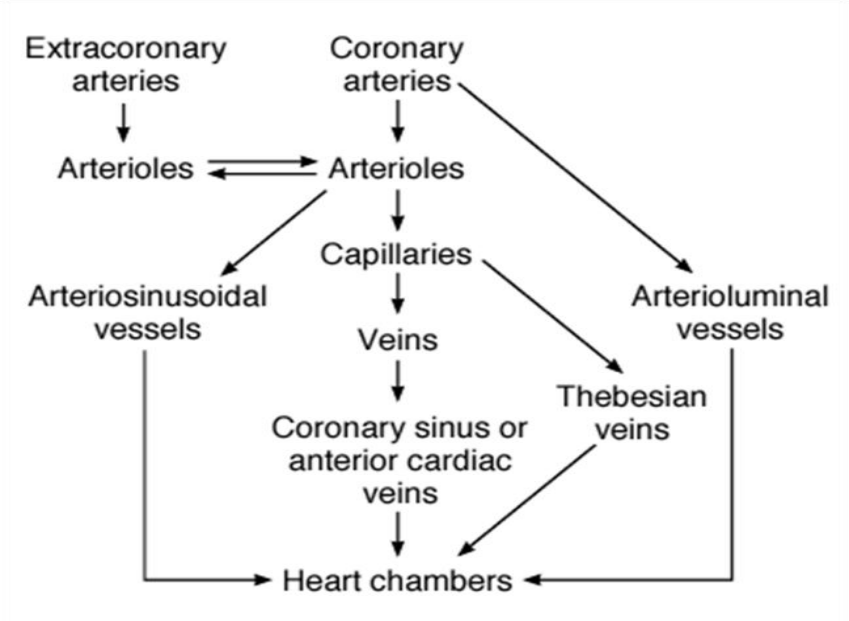
- LCA(Left main Coronary Artery) divides into
- Left Anterior Descending (LAD) - gives septal and diagonal branches
- Circumflex Artery (LCX)- gives marginal branches and occasionally the posterior descending artery
- RCA (Right Coronary Artery) gives off

– Atrial branches,conus branch,marginal branches

– SA nodal, AV nodal and septal branches

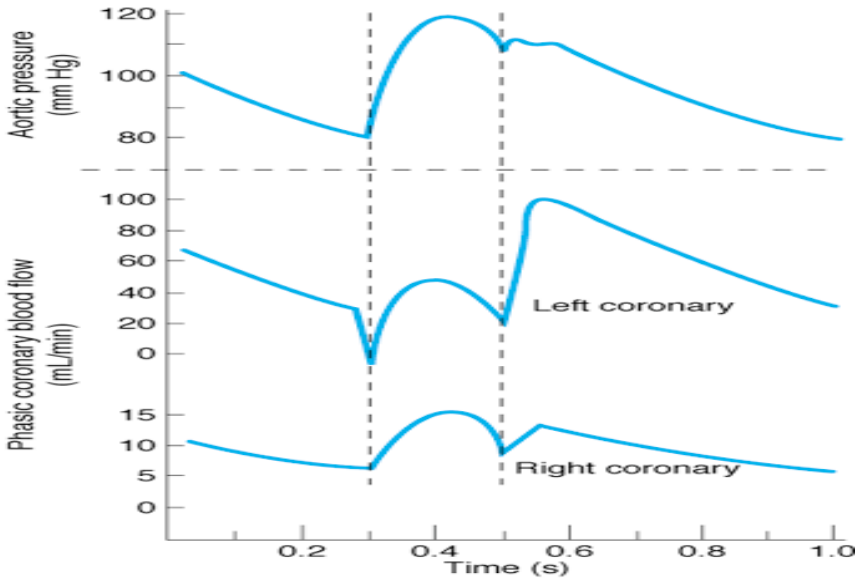
– Posterior descending branch

CORONARY CIRCULATION



Coronary blood flow in humans during rest is about 225-250 ml/minute, which is about 5% of cardiac output. At rest the heart extracts 60-70% of oxygen from each unit of blood delivered to it -other tissues extract only 25% of O2-as myocardium has more mitochondria, occupying upto 40% of the myocyte. When more oxygen is needed as in exercise, O_2 delivery can be increased only by increasing the blood flow. During systole when the heart contracts it compresses the coronary arteries, therefore blood flow to the left ventricle is less during systole and more during diastole. The subendocardial portion of left ventricle is perfused only during diastole. Coronary blood flow to the right ventricle is not much affected during systole as the pressure difference between aorta and right ventricle is greater during systole than in diastole. Hence more blood flow occurs to the right ventricle during systole.

CORONARY BLOOD FLOW



As we know blood flow to subendocardial region of left ventricle is nil during systole and is therefore prone to ischemic damage and is the most common site of myocardial infarction. Heart uses primarily free fatty acids and to a lesser extent glucose and lactate for metabolism. In ischemic / anaerobic conditions it derives energy from anaerobic glycolysis forming lactic acid, one of the causes of cardiac pain.

FACTORS AFFECTING BLOOD FLOW TO CORONARY ARTERIES

- Aortic pressure
- Chemical factors
- Neural factors

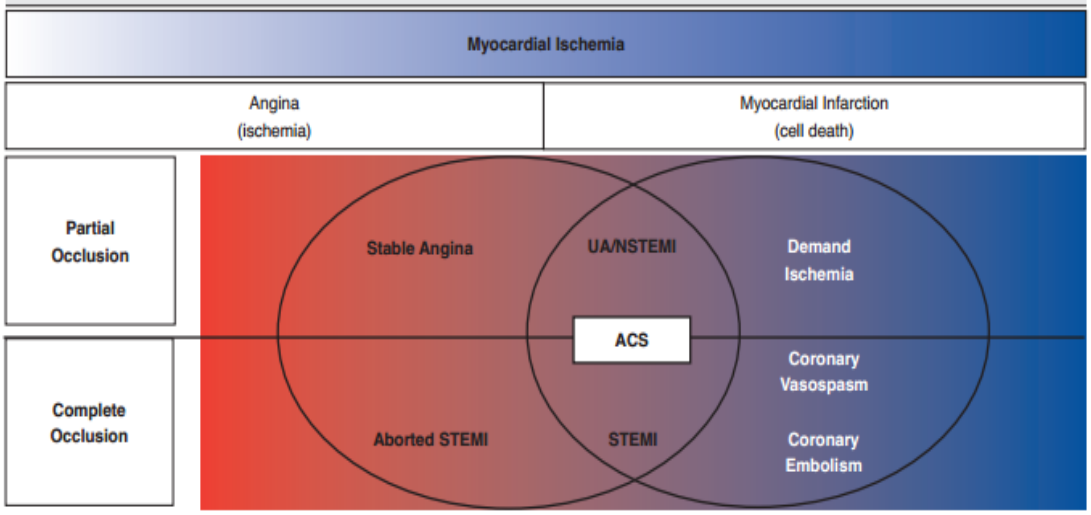
Coronary blood flow shows considerable autoregulation.

<u>Chemical factors affecting Coronary blood flow</u>

- ⦿ Chemical factors causing Coronary vasodilatation (Increased coronary blood flow)
    - Lack of oxygen
    - Increased local concentration of Co_2
    - Increased local pH
    - Increased local concentration of K^+
- Increased local concentration of lactate, prostaglandins, adenine nucleotides.

- Adenosine formed from ATP during cardiac metabolic activity
    - **Neural factors affecting Coronary Blood Flow**
    - Effect of Sympathetic stimulation
    - Effect of Parasympathetic stimulation
- Sympathetic stimulation: Coronary arteries have Alpha Adrenergic receptors that cause vasoconstriction and Beta Adrenergic receptors that cause vasodilatation.
- Effect of Parasympathetic stimulation : Vagal stimulation causes coronary vasodilatation.

Figure 1. Characteristics Of Myocardial Ischemia



Stable Angina	UA/NSTEMI	STEMI	Other MI
Chest pain[a] (-) ECG changes (-) Cardiac enzymes	Chest pain[a] Nonspecific ECG changes (+/-) Cardiac enzymes	Chest pain[a] ECG ST elevations[b] (+/-) Cardiac enzymes	(+/-) Chest pain (+/-) ECG changes (+) Cardiac enzymes

SPECTRUM OF CORONARY ARTERY DISEASE:

Patients who have CAD may present with stable angina or ACS (Acute Coronary Syndrome). Acute coronary syndrome includes UA (Unstable Angina) and MI with or without ST-segment elevation . Unstable angina is characterised by increase in the duration, severity and frequency of chest pain, with or without ST depression or T wave inversion in ECG. The clinical manifestations of non ST elevation MI is similar to Unstable angina and its differentiated from the later by the presence of cardiac enzymes.

MYOCARDIAL INFARCTION

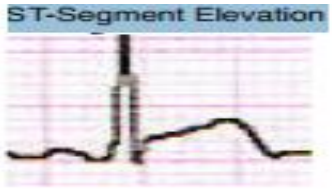
DEFINITION

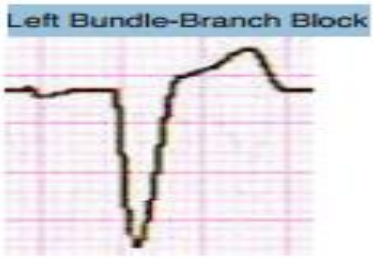
Criteria for Acute, Evolving, or Recent MI

Either of the following criteria satisfies the diagnosis for acute, evolving, or recent MI:

1. Typical rise and/or fall of biochemical markers of myocardial necrosis with at least one of the following:
   - **a)** Ischemic symptoms
   - **b)** Development of pathological Q waves in the ECG
   - **c)** ECG changes indicative of ischemia (ST segment elevation or depression)
   - **d)** Imaging evidence of new loss of viable myocardium or new regional wall motion abnormality

ECG evidence of ST-segment elevation of more than 1mm in two or more contiguous limb leads (from aVL to III, including aVR),





ST-segment elevation more than 1 mm in precordial leads

V4 through V6,ST-segment elevation more than 2 mm in precordial leads V1 through V3, or New left bundle-branch block.

For diagnosing the occurrence of MI in patients with chest pain and LBBB, Sgarbossa scoring system was devised that takes into account

1. ST-segment elevation ≥ 1 mm in a lead with positive QRS complex (5 points)
2. ST-segment depression ≥ 1 mm in V1, V2, or V3 (3 points)
3. ST-segment elevation ≥ 5 mm in a lead with negative QRS complex (2 points)

Scores > 3 has 90% specificity for MI. Criteria 1 is more specific of a ST elevation MI than criteria 3, and as more criteria is fulfilled, the more likely that the patient is suffering from MI.

Positive tests for cardiac enzymes troponin and creatinine kinase isoenzyme MB are helpful, but not essential.[1] Secondary ST wave changes in the leads corresponding to the opposite side of the heart) make the diagnosis of STEMI more specific.

CLASSIFICATION OF MI

TYPE	FEATURES
1	Spontaneous myocardial infarction related to ischemia caused by a primary coronary event such as plaque erosion and/or rupture, fissuring, or dissection
2	Myocardial infarction secondary to ischemia caused by increased oxygen demand or decreased supply (e.g., coronary artery spasm, coronary embolism, anemia, arrhythmias, hypertension, hypotension)
3	Sudden unexpected cardiac death, including cardiac arrest, often with symptoms suggestive of myocardial ischemia, accompanied by presumably new ST-segment elevation, or new LBBB, or presumably new major obstruction in a coronary artery by angiography and/or pathology, but death occurring before blood samples could be obtained, or before the appearance of cardiac biomarkers in the blood
4a	Myocardial infarction associated with PCI
4b	Myocardial infarction associated with stent thrombosis, as documented by angiography or autopsy
5	Myocardial infarction associated with CABG

I .CONVENTIONAL RISK FACTORS

II.UNCONVENTIONAL RISK FACTORS

The conventional risk factors can be further divided into non modifiable risk factors & potentially modifiable risk factors.

THE NON MODIFIABLE RISK FACTORS

1. Increasing age

84 % of people who die of coronary artery disease are 65 years or older. In old age the chance of occurrence of Myocardial infarction increases due to the deposition of atherosclerotic plaques in the blood vessels. Age also increases the morbidity of the disease persay.

2. Male sex (gender)

Men are at an increased risk for the development of Myocardial Infarction than women. Oestrogen seems to have a protective role against M.I. After menopause the risk is almost equal in men and women.

3. Heredity including Race

Incidence of M.I is higher in South Asian population. Family history of CAD especially paternal history of Myocardial infarction is associated with increased occurrence of premature myocardial Infarction in young men and its probably due to accelerated atherosclerotic process.

THE POTENTIALLY MODIFIABLE RISK FACTORS

1. Tobacco Smoking

It contributes to one quarter of CAD deaths in young men ,and lot of awareness has been created regarding smoking. Tobacco smoking increases the risk of M.I. by 2-4 times and cigarette smokers have twice

the risk of sudden cardiac death than non smokers. It significantly contributes to the atherosclerotic process and also synergises with other risk factors to greatly increase the risk of coronary artery disease. Exposure to other peoples' smoke ie. passive smoking also increases the risk of heart disease in non-smokers.

2. Dietary Factors

There exists a triangular relationship between the habitual diet, blood cholesterol - lipoprotein levels and coronary artery disease. Increased intake of food containing saturated and mono unsaturated (trans) fatty acids and decreased consumption of poly unsaturated fatty acids increases the risk for myocardial infarction.

The Seven Countries Study showed that serum **cholesterol** is an important risk factor for the incidence of CAD at levels of 220 mg/dl or more. The level of low- density lipoprotein (LDL) is directly associated with CAD. Very low density lipoprotein (VLDL) is shown to be associated with premature atherosclerosis. High Density lipoprotein (HDL) is protective against the occurrence of CAD. HDL levels should be more than 30 mg/dl to exert a protective effect and LDL levels should ideally be less than 200 mg/dl.

Increased salt consumption is associated with the development of hypertension which in turn increases the risk of M.I.

3. Hypertension

Hypertension fastens the atherosclerotic process and increases the risk of myocardial infarction. According to the current data, 30 % of the patients with hypertension develop myocardial infarction. Systolic blood pressure predicts the occurrence of CAD better than diastolic blood pressure.

4. Diabetes Mellitus

Today diabetes is considered as a CAD equivalent. The risk of CAD is 2-4 times higher in diabetics than in non- diabetics. CAD accounts for 30-50 % of deaths in diabetics above the age of 40 years in industrialized countries. They suffer twice the morbidity and mortality when compared to non – diabetics.

5. Obesity and Physical Inactivity

In the current era, obesity is high and its becoming one of the major risk factors in the occurrence of MI. Central obesity (intra abdominal fat deposition) is an important determinant for the development of insulin resistance and metabolic syndrome (hyperinsulinemia, dyslipidemia, glucose intolerance and hypertension).

This again links obesity to CAD. Physical inactivity and sedentary occupation leads to decreased energy expenditure and is the most important etiology of obesity. Exercise plays a major role in retarding the development of obesity.

6. Metabolic Syndrome

Metabolic Syndrome worsens CAD. Criteria includes:

Increased waist circumference (Asian Males > 90 cm, Females > 80 cm) plus at least 2 of the following:-

1) Triglyceride ≥ 150 mg/ dl
2) HDL – Cholesterol < 40 mg/dl (men); 50 mg / dl (women) or on HDL – cholesterol treatment
3) Systolic BP ≥ 130 and/or Diastolic BP ≥ 85 mm Hg.
4) Fasting Blood glucose ≥ 100 mg / dl or Impaired Glucose Tolerance Test or known diabetic.

II. Unconventional / Emerging Risk Factors

1. **Homocysteine :**

Increased levels of homocysteine causes cardiovascular disease. Diets rich in dietary fibre and low in monounsaturated fatty acids decrease the level of homocysteine.

2) Malnutrition

Type B malnutrition occurs due to high calorie and low micronutrient intake and can cause obesity leading to an increased risk of CAD.

3) Depression

Depressive patients are more likely to develop CAD when compared to non depressive patients. Treatment of depression improves the outlook of patients with CAD.

4) Cocaine

According to a study done by the National Heart Lung and Blood Institute, the American Heart Association reports that the risk of myocardial infarction was elevated by 23.7 times in 60 minutes after cocaine use. Cocaine causes spastic contraction of the coronary blood vessels that leads to myocardial ischemia and increases the rise of M.I.

CAUSES OF MI

Atherosclerosis of the coronary arteries is the most important and most common cause of MI. However numerous pathological processes other than atherosclerosis contribute to MI. For example, coronary artery occlusions can result in embolization to the coronary arteries. Emboli most commonly lodge in the left anterior descending artery, more so in

the epicardial and transmural branches. The etiology of coronary embolism are numerous like infective endocarditis and nonbacterial thrombotic endocarditis, mural thrombi, prosthetic valves, neoplasms, air that is introduced at the time of cardiac surgery and calcium deposits from manipulation of calcified valves at operation. In situ thrombosis of coronary arteries can occur secondary to chest wall trauma.

A variety of inflammatory processes can be responsible for coronary artery abnormalities, some of which mimic atherosclerotic disease and may predispose to true atherosclerosis. Epidemiological evidence suggests that viral infections, particularly with coxsackie B, may be an uncommon cause of AMI. Viral infections precede AMI occasionally in young persons who are later shown to have normal coronary arteries.

Syphilitic aortitis may produce marked narrowing or occlusion of one or both coronary ostia, whereas Takayasu's arteritis may result in obstruction of the coronary arteries. Necrotising arteritis, polyarteritis nodosa, mucocutaneous lymph node syndrome (Kawasaki disease), systemic lupus erythematosus and giant cell arteritis can cause coronary occlusion. Therapeutic levels of mediastinal radiation can cause thickening and hyalinization in the walls of coronary arteries, with subsequent infarction. AMI may also be the result of coronary arterial

involvement in amyloidosis, hurler syndrome, pseudoxanthoma elasticum and homocystinuria.

As cocaine abuse has become more common, reports of AMI following the use of cocaine has appeared with increasing frequency. Cocaine may cause AMI in patients with normal coronary arteries, pre-existing MI, documented coronary artery disease or coronary artery spasm.

Pathophysiology of ST ELEVATION MI

[8]Myocardial infarction (MI) is due to obstruction to coronary blood flow, with atleast 75 % of the lumen being blocked by thrombus. The process of atheroma formation involves the intima of large and medium arteries. Progesses overtime, before manifesting itself as an ACS. The whole pathophysiology of MI involves a complex interplay between the endothelium, inflammatory mediators and coagulability of blood. After the plaque ruptures, the sub endothelial matrix is exposed to the circulating blood; this exposure leads to platelet adhesion followed by platelet activation and aggregation and the subsequent formation of thrombus. Two types of thrombi can form : a platelet rich clot(white clot) that forms at areas of high shear stress and partially occludes the artery, or fibrin rich clot (a red clot) that is the result of an activated coagulation

cascade and decreased flow in the artery. Red clots are frequently superimposed on white clots, and cause total occlusion resulting in STEMI ; when occlusion is sub total , UA/ NSTEMI are usually the result[9].

The high risk vulnerable plaques are composed of a lipid rich centre , thin fibrous caps, a relative high number of macrophages and T lymphocytes, a relative few smooth muscle cells, increased expression of matrix metalloproteinases ,eccentric outward remodelling and increased neovascularity of the plaque and intraplaque haemorrhage. Inflammation ,an important determinant of the vulnerability of plaques , is related to an increase in the activity of macrophages at the site of plaque. Seventy percent of lesions on coronary angiography that cause ACS are less than 50% stenosis of arterial diameter. So most ACS episodes are due to rupture of non obstructive plaques. The plaque usually ruptures at shoulder point.

Several complications may develop like haemorrhage into the atheroma, ulceration of the intimal surface, embolization of the atheromatous plaque, thrombosis starting at the narrowed portion of the arteries, and calcification. Progressive occlusion of the lumen of the coronary arteries may remain totally asymptomatic till the circulation is considerably diminished. In general, the development of complications

gives rise to one of the clinically detectable syndromes. Once a coronary artery is occluded and the myocardium rendered ischaemic, gross changes are noticeable by six hours. The infarct appears pale, blue and edematous. Early histological features are interstitial edema, neutrophilic infiltration and clumping of muscle cells. Granulation tissue appears by the tenth day. The infarct is converted into a scar by the sixth week. An infarct may involve the total thickness of the ventricular myocardium (transmural infarcts) or may be confined to the sub endocardial region depending on the vessel occluded.

Further changes may develop over the area of initial infarction. These are 1. Extension of infarct leading to further loss of ventricular function.

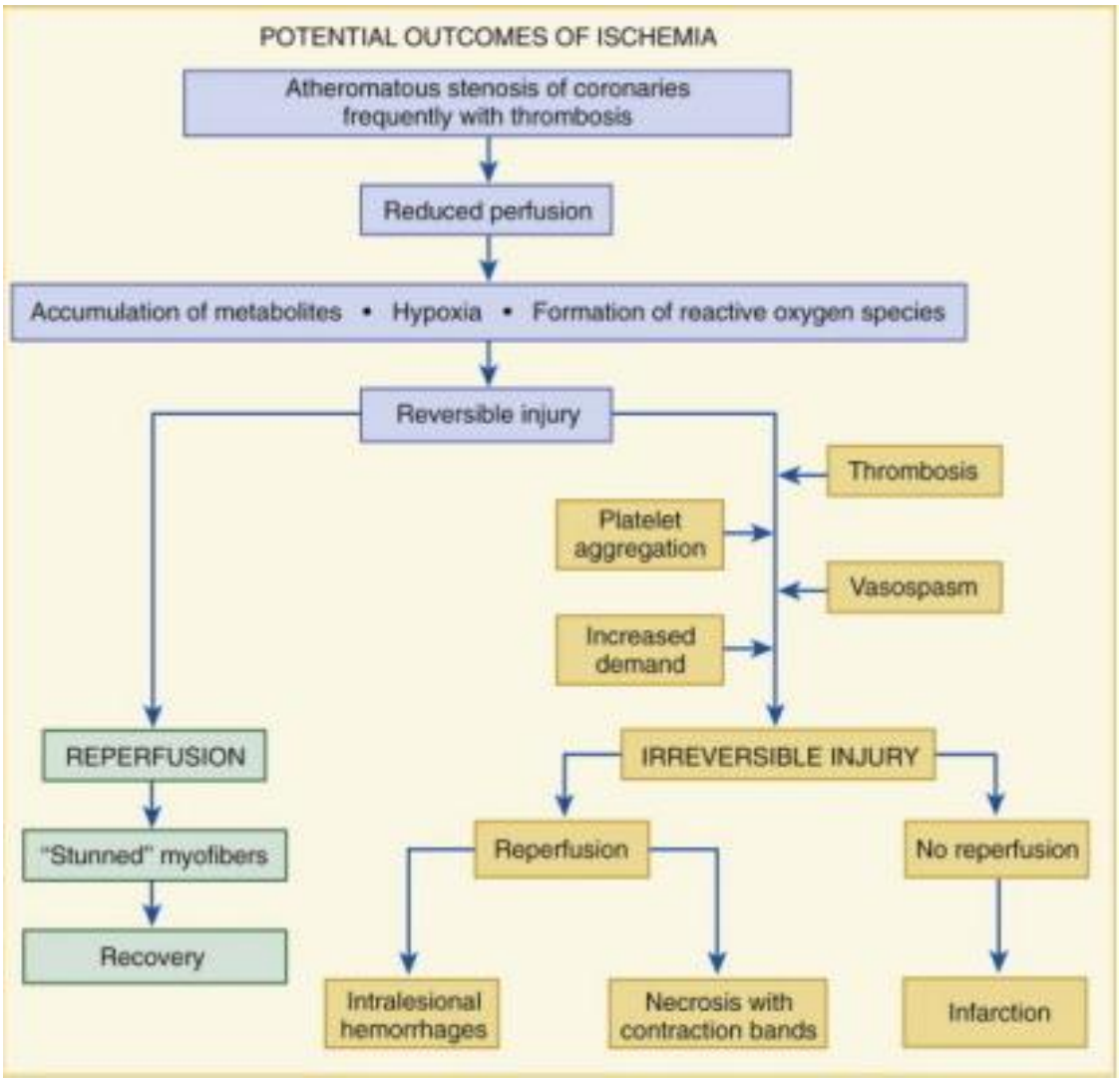
2. Involvement of conducting tissues leading to disruption of impulse conduction .

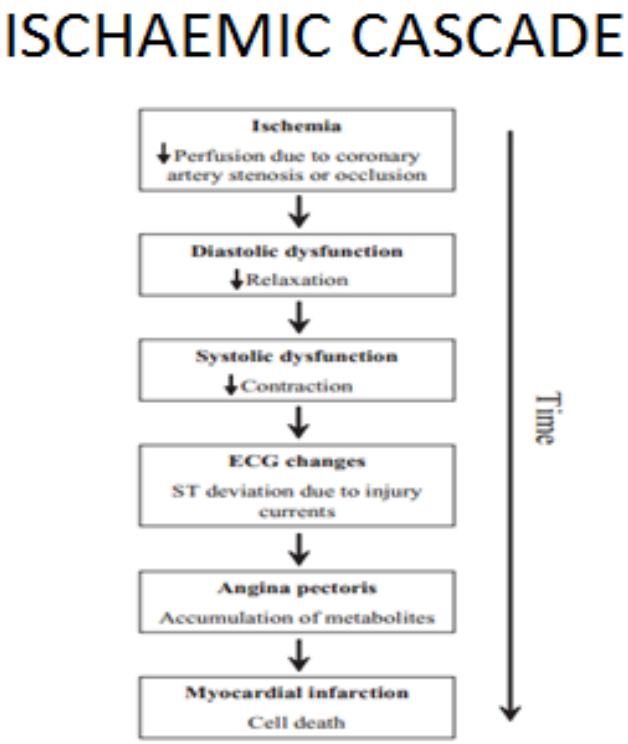
3. Rupture of the infarct resulting in hemopericardium.

4. Inflammation of the overlying pericardium giving rise to pericarditis and

5. Formation of ventricular aneurysm. The ischaemic myocardium is electrically unstable and this acts as a focus for ectopic impulses, which

give rise to several arrhythmias in the immediate post infarcation period.





- **ISCHAEMIC PRE CONDITIONING AND COLLATERAL FLOW**

[23]In addition to the duration of ischemia, there are other factors that affect the consequences of coronary occlusion. If the myocardium is subjected to repetitive short ischemic episodes, it increases its protection against subsequent prolonged ischemic episodes. It has been shown to reduce the level of ST-segment deviation and decrease MI size.[15] The mechanisms for the preconditioning are complicated and not fully elucidated. They involve a much lower consumption of ATP, delayed development of acidosis and slower accumulation of lactate in

preconditioned compared to the non preconditioned myocardium. [13]This suggests that preconditioned myocardium has a reduced energy requirement and consequently a delayed myocyte death when the blood flow is disrupted .The concept of ischemic preconditioning in humans has been supported by many clinical trials.

- **Myocardial stunning[14].**

The normalization of cardiac function can be preceded by a relatively brief period of decrease in cardiac function (hypokinesia) caused by myocardial stunning. Stunned myocardium has been defined by Braunwald and Kloner as "prolonged, postischemic dysfunction of viable tissue salvaged by reperfusion". Thus, myocardial stunning[14] may occur even without MI. The time and degree of recovery of cardiac function in stunned myocardium depends on the duration and severity of ischemia and on the adequacy blood flow restoration.

- **Myocardial hibernation[16]**

A reduction in myocardial function can also be caused by a persistent decrease in blood flow due to a tight coronary stenosis. The blood supply to the myocardium in the area distal to the stenosis is very low for the myocardium to contract properly but is sufficient for it to remain viable. This phenomenon is called myocardial hibernation and has

been described as "a state of persistently impaired myocardial and LV function at rest due to reduced coronary blood flow which can be partially or completely restored to normal if the myocardial oxygen supply/demand relationship is favorably altered, either by improving blood flow and/or by decreasing the demand." Thus the hibernating myocardium has the ability to recover its function in contrast to myocardium that is infarcted.

- **[13]Myocardial remodelling.**

In situations where the MI is large enough to cause permanent partial loss of cardiac function, there is a need to compensate for this functional loss.[14] The changed loading conditions stimulate myocardial remodelling, which can alter the topography of both the infarcted and viable myocardium. An early alteration of the infarcted myocardium, especially in transmural MI, is infarct expansion. Infarct expansion is defined as "acute dilatation and thinning of the area of infarction that cannot be explained by additional myocardial necrosis."[25] Depending on the extent of MI, the remodelling process varies from well adapted compensatory hypertrophy called as positive remodelling to pronounced wall thinning and aneurysm formation referred to as negative remodelling. As the MI size increases, the risk of ventricular dilatation and heart failure subsequently increases.

CLINICAL PRESENTATION

Likelihood that signs and symptoms represent an acute coronary syndrome secondary to coronary disease

Feature	High likelihood	Intermediate likelihood	Low likelihood
	Any of the following:	Absence of high-likelihood features and presence of any of the following:	Absence of high- or intermediate-likelihood features but may have:
History	Chest or left arm pain or discomfort as chief symptom reproducing prior documented angina	Chest or left arm pain or discomfort as chief symptom	Probable ischemic symptoms in absence of any of the intermediate likelihood characteristics
	Known history of CAD, including MI	Age >70 years Male gender Diabetes mellitus	Recent cocaine use
Examination	Transient mitral regurgitation, hypotension, diaphoresis, pulmonary edema, or rales	Extracardiac vascular disease	Chest discomfort reproduced by palpation
ECG	New, or presumably new, transient ST-segment deviation (≥0.5 mm) or T-wave inversion (≥2 mm) with symptoms	Fixed Q waves	T-wave flattening or inversion in leads with dominant R waves
		Abnormal ST segments or T waves not documented to be new	Normal ECG
Cardiac markers	Elevated cardiac troponin I, troponin T, or CK-MB	Normal	Normal

MI is characterised by the occurrence of severe retrosternal pain with the characteristic radiation to the jaw, shoulder and back. The pain is usually severe and excruciating and is usually described as compressive pain not relieved with rest or sublingual nitroglycerine and its associated with dyspnoea, excessive sweating, vomiting, palpitations. It is important

to know the time of onset of chest pain, as its important in determining the means of reperfusion. ST elevation MI may have atypical presentations in women, elderly and post operative patients as well as those with diabetes and chronic kidney disease. Some patients may present with anginal equivalents like dyspnoea, syncope, palpitations , unexplained hypotension or congestive cardiac failure. If the patient has a history of previous cardiac catherisation or revascularisation its important to obtain these records, as these provide valuable information with respect to PCI planning. MI follows the circardian rhythm in that a good number of cases occur in the early hours of morning.

SIGNS :

Physical findings should be directed towards identifying hemodynamic instability, pulmonary congestion, mechanical complications of MI, and other causes of acute chest discomfort. In 20% of cases the symptoms may be trivial and physical examination may be unrewarding, however in a few the findings are characteristic. The identification of a new pan systolic murmur may suggest the presence of ischaemic MR (mitral regurgitation), or VSR (ventricular septal rupture). A neurological assessment should be done to detect motor deficits and vascular examination like peripheral pulses and bruits should be looked for . Cardiogenic shock due to right ventricular myocardial

infarction or extensive anterior wall MI should be be clinically suspected in the presence of feeble pulses, low or unrecordable BP and a raised jugular venous pressure. While RV MI may be seen in isolation, it may be more commonly associated with inferior/ posterior MI . Bilateral arm BPs should be obtained to assess for the presence of aortic dissection.

On the second or third day pericardial friction rub may be heard or a pericardial effusion may develop. If complication develop these will be clinically evident.

Based on Clinical Examination*		Based on Invasive Monitoring[†]	
CLASS	DEFINITION	SUBSET	DEFINITION
I	Rales and S_3 absent	I	Normal hemodynamics; PCWP < 18 mm Hg, CI > 2.2
II	Crackles, S_3 gallop, elevated jugular venous pressure	II	Pulmonary congestion; PCWP > 18 mm Hg, CI > 2.2
III	Frank pulmonary edema	III	Peripheral hypoperfusion; PCWP < 18 mm Hg, CI < 2.2
IV	Shock	IV	Pulmonary congestion and peripheral hypoperfusion; PCWP > 18 mm Hg, CI < 2.2

INVESTIGATIONS

ENZYMES: Several enzymes and other components of cardiac muscle are liberated into the circulation from injured and necrotic myocardium. Their presence above diagnostic levels, their peak levels in plasma and the pattern of their rise and fall, have been established.

CPK MB: it's a high energy transfer cytoplasmic protein which originates from cardiac and skeletal muscle. Its detectable within 2- 3 hours, 94% sensitivity at 8 hours and < 50% at 2 hours. It returns to normal in 24 – 48 hours. Advantage is that it can detect early reinfarction. Low sensitivity for detection of very early (<6 hours) MI small MI ; false positive with skeletal muscle trauma, CPR, Cardioversion and cardiac surgery.

MYOGLOBIN:

Its an O_2 binding haem protein that is rapidly released with myocyte injury. It originates from cardiac and skeletal muscle, detectable within 1.5 – 2 hours and returns to normal in 8 to 12 hours. It is marker to detect very early MI.

CARDIAC TROPONINS:

These are regulatory proteins for calcium dependent interactions between actin and myosin. They originate from the cardiac muscle, released within 3–4 hours, return to normal within 10–14 days. Troponins are sensitive and specific than CPK –MB. It's the best marker for MI with skeletal muscle injury, small MI, or late MI (> 2 -3 days). Low sensitivity for detection of early MI or late reinfarcation.

SUBSET	TOTAL CPK	CK -MB	MYOGLOBIN	CARDIAC TROPONIN
MI < 4 HOURS	_	_	+	_
MI 4 – 12 HOURS	+	+	+	+
MI > 2 TO 10 DAYS	_	_	_	≥
EARLY REINFARCTION	+	+	≥	_
SMALL MI	_	_	_	+
MI AFTER OPERATION OR TRAUMA	_	≥	_	+

+ USEFUL, ≥ SOME VALUE, - NOT USEFUL.

ECG IN MI :

- [12]While coronary angiography remains the “gold standard” for identifying the infarct related artery, the ECG remains the gold standard for identifying the presence and location of acute myocardial ischaemia. A possible consequence of myocardial ischemia is myocyte death. ECG abnormalities are not due to injury currents, but rather due to the established MI. MI affects the local activation sources of the myocardium, seen as deviation of the QRS waveforms away from an electrode overlaying the infarcted area. It might also

cause persistent alteration of myocardial repolarization, resulting in T wave alterations. The QRS complex is altered to a considerable degree in variable leads depending on the size, location and morphology of the MI. The extent of MI is dependent on which vessel is occluded. The myocardial activation (depolarization) vector is a result of all parts of the myocardium that are depolarized at a given time point. The result of the time resolved propagation of the depolarization vector during a single cardiac cycle is what causes the deflections of the QRS complex seen in different leads. Regions of MI will influence the normal depolarization vector according to the size, location and morphology of the MI. If the initial depolarization forces are directed away from an overlying lead, the initial QRS deflection in that lead will be negative, resulting in a Q wave. Thus, presence of Q waves can be a sign of MI.

Table 1. Infarction Distribution With ST-Segment Elevation Myocardial Infarction And Consequences[4,15-17]

ST Elevations	Affected Coronary Artery	Area of Damage	Complications
V_1 through V_4	Left coronary artery: Left anterior descending	Anterolateral heart wall Septum Left ventricle His bundle Bundle branches	Left ventricular dysfunction: Decreased carbon dioxide, congestive heart failure Left bundle-branch block Right bundle-branch block Left posterior fascicular block Infranodal block (2°or 3°)
V_5 through V_6, I, aVL	Left coronary artery: Left circumflex branch	Left lateral heart wall	Left ventricular dysfunction: Decreased carbon dioxide, congestive heart failure Infranodal block (2°or 3°)
II, III, aVF, V_4R	Right coronary artery: Posterior descending branch	Inferior heart wall Right ventricle	Hypotension (particularly with nitroglycerin and morphine, which can decrease preload) Supranodal 1° heart block Atrial fibrillation/flutter, premature atrial contractions Infranodal block (2°and 3°) Papillary muscle rupture (murmur)
V_8 and V_9 (or ST depressions in V_1 and V_2)	90% Right coronary artery: Posterior descending branch 10% Left coronary artery: Left circumflex branch (will see elevations in V_5 through V_6)	Posterior heart wall	Hypotension Supranodal 1° heart block Infranodal block (2°and 3°) Atrial fibrillation/flutter, premature atrial contractions Papillary muscle rupture (murmur)

ECHOCARDIOGRAPHY :

This may reveal wall motion abnormalities, chamber size, myocardial fibrosis, edema, thinning of ventricular wall, hypertrophy, and others. It can help to evaluate cardiac hemodynamics by using colour Doppler. It may also be used to identify the progress from ischaemia to infarction.

NUCLEAR IMAGING:

Radionuclide imaging, angiography, perfusion imaging, infarct avid scintigraphy and positron emission tomography area all in the use to study the nature of the myocardial lesion, its viability and prognosis.

CORONARY ANGIOGRAPHY :

Angiography is the key in diagnosing the extent, location, and severity of lesions and in planning revascularisation (PCI or CABG). More than 80% of patients with UA/ NSTEMI show significant coronary lesions on coronary angiography.

ESTIMATION OF INFARCT SIZE[12]

- Its essential to estimate the size of infarct as it has got a significant value in terms of prognosis and many clinical methods have been evaluated to determine their ability to estimate in the size of myocardial infarcts. Early estimation of infarct size is necessary for predicting the severity of infarction and planning the rehabilitation program. Methods of estimating infarct size include
- **CPK**
- **ECG**
- **CEMRI**
- A[12]new method to estimate infarct size is using dual single photon emission computed tomography (dual SPECT) with 201 T1 and technetium-99m pyrophosphate.

For determining the presence and location of infarcts however, the 12-lead ECG remains the standard because it is universally available,

noninvasive, inexpensive and easily repeatable. It is important to know the extent to which ECG could be used for estimating infarct size.

Studies of the sequence of activation in QRS complexes in both canine and human hearts have provided the basis for computer simulations that suggest an orderly and predictable sequence of changes that occurs in QRS associated with infarcts of various locations and sizes. Through various pilot studies in patients with localized wall motion abnormalities seen by ventriculography, Selvester et al. refined the results of these computer simulations to produce both qualitative and quantitative criteria for determining infarct size.

SELVESTER QRS SCORING SYSTEM

The Selvester QRS Score which is an electrocardiographic (ECG) method for estimating MI size, was first proposed by Selvester et al and it was later modified by Wagner and Palmeri. The Selvester QRS score, which was first put forth in the year 1972, converts the changes in cardiac electrical activity into information that help us in determining the infarct size and location.

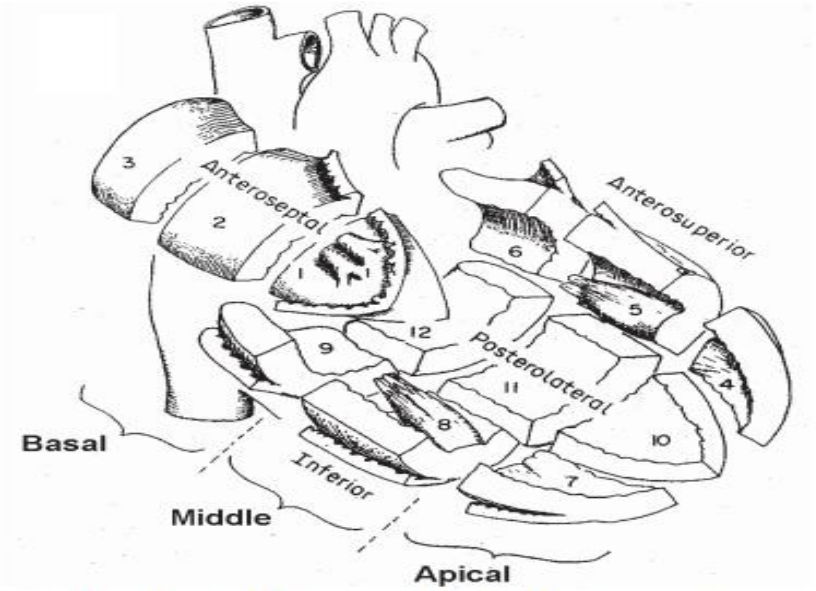


FIGURE 1.4 Subdivision of the left ventricle into 12 segments. The 12-segment model is used for describing the local MI extension by the Selvester QRS scoring system. In paper I and IV the

- The infarct size estimated by this scoring system has shown to have a reliable and good correlation with the myocardial infarct size measured at autopsy. Various studies have proved that the QRS score estimated in the patients post MI provided valuable information regarding prognosis. Higher QRS score is indicative of increased occurrence of ventricular tachyarrhymthias and the need for increased defibrillatory shocks and decreased response to cardiac resynchronisation therapy. The size of a myocardial infarct is estimated electro cardiographically using this QRS scoring system to accumulate a point score. [12]Ten ECG leads (1,II, aVL, aVF, V1-V6) are weighted according to their ability to reflect infarct size as established by Selvester etal. Certain criteria in the original scoring system are not evaluated. Qualitative criteria, such as

slurs or notches, are not considered because of the difficulty of establishing definitions that can be applied uniformly to clinically performed ECGs from a large number of patients.

Complete 50-Criteria, 31-point QRS Scoring System*

Lead	Maximum Lead Points	Criteria	Points
I	(2)	Q ≥ 30ms	(1)
		R/Q ≤ 1	(1)
		R ≤ 0.2mV	(1)
II	(2)	Q ≥ 40ms	(2)
		Q ≥ 30ms	(1)
aVL	(2)	Q ≥ 30ms	(1)
		R/Q ≤ 1	(1)
aVF	(5)	Q ≥ 50ms	(3)
		Q ≥ 40ms	(2)
		Q ≥ 30ms	(1)
		R/Q ≤ 1	(2)
		R/Q ≤ 2	(1)
V1			
Anterior	(1)	Any Q	(1)
Posterior	(4)	R/S ≥ 1	(1)
		R ≥ 50ms	(2)
		R ≥ 1.0mV	(2)
		R ≥ 40ms	(1)
		R ≥ 0.6mV	(1)
		Q and S ≤ 0.3mV	(1)
V2			
Anterior	(1)	Any Q	(1)
		R ≤ 10ms	(1)
		R ≤ 0.1mV	(1)
		R ≤ RV_1 mV	(1)
Posterior	(4)	R/S ≥ 1.5	(1)
		R ≥ 60ms	(2)
		R ≥ 2.0mV	(2)
		R ≥ 50ms	(1)
		R ≥ 1.5mV	(1)
		Q and S ≤ 0.4mV	(1)
V3	(1)	Any Q	(1)
		R ≤ 20ms	(1)
		R ≤ 0.2mV	(1)
V4	(3)	Q ≥ 20ms	(1)
		R/S ≤ 0.5	(2)
		R/Q ≤ 0.5	(2)
		R/S ≤ 1	(1)
		R/Q ≤ 1	(1)
		R ≤ 0.7mV	(1)
V5	(3)	Q ≥ 30ms	(1)
		R/S ≤ 1	(2)
		R/Q ≤ 1	(2)
		R/S ≤ 2	(1)
		R/Q ≤ 2	(1)
		R ≤ 0.7mV	(1)
V6	(3)	Q ≥ 30ms	(1)
		R/S ≤ 1	(2)
		R/Q ≤ 1	(2)
		R/S ≤ 3	(1)
		R/Q ≤ 3	(1)
		R ≤ 0.6mV	(1)

*When more than one criterion in the brace is met, the one with the most points is selected (1 point = 3% of myocardium infracted).

TABLE 3. *Modified QRS Scoring System*

Lead	Duration (msec)		Amplitude ratios		Max points
I	$Q \geq 30$	(1)	$R/Q \leq 1$	(1)	2
II	$Q \geq 40$	(2)			
	$Q \geq 30$	(1)			2
aV_L	$Q \geq 30$	(1)	$R/Q \leq 1$	(1)	2
	$Q \geq 50$	(3)	$R/Q \leq 1$	(2)	
aV_F	$Q \geq 40$	(2)			
	$Q \geq 30$	(1)	$R/Q \leq 2$	(1)	5
	Any Q	(1)			
V_1	$R \geq 50$	(2)			
	$R \geq 40$	(1)	$R/S \geq 1$	(1)	4
	Any Q or $R \leq 20$	(1)			
V_2	$R \geq 60$	(2)			
	$R \geq 50$	(1)	$R/S \geq 1.5$	(1)	4
V_3	Any Q or $R \leq 30$	(1)			1
V_4	$Q \geq 20$	(1)	R/Q or $R/S \leq 0.5$	(2)	
			R/Q or $R/S \leq 1$	(1)	3
V_5	$Q \geq 30$	(1)	R/Q or $R/S \leq 1$	(2)	
			R/Q or $R/S \leq 2$	(1)	3
V_6	$Q \geq 30$	(1)	R/Q or $R/S \leq 1$	(2)	
			R/Q or $R/S \leq 3$	(1)	3

The modified Selvester QRS scoring system achieves an acceptable level of specificity when confounding variables such as left or right ventricular hypertrophy, left or right bundle branch block, or left anterior or posterior fascicular block are excluded. Each criterion exhibited at least 95% specificity and the total 29-point scoring system achieved 98% specificity when a score of more than 2 points was required for identification of infarction. The confounding variables noted above will probably diminish the specificity,thus limiting the value of this scoring system for identifying and measuring infarct size in some patients.

However, the specificity must be established. Some of the criteria may retain their importance in the presence of other factors that can alter the QRS complex. The QRS scoring system also allows acceptable levels of both intra and inter observer agreement.Each of the 37 criteria achieved 91% or greater intraobserver agreement and 92% or greater interobserver agreement.

QRS SCORING AND EJECTION FRACTION

QRS changes resolve owing to healing that occurs in the infarcted area, its associated with scar retraction and hypertrophy of the nearby myocardium and it has been established to be indicative of retained LV function. It has been validated in many studies that early reperfusion strategies acclerate the healing process and recovery of LV dysfunction and bring about resolution in QRS changes.

PROGNOSTIC VALUE OF QRS SCORING

Higher QRS score is associated with higher mortality in patients with MI. Patients with a score of 0 had a survival rate of 95% at the end of one year and 88% survival at the end of five years; patients with a score of ten or more had survival rates of 81% and 52%, respectively ,at one and 5 year intervals.

Though the size of the infarct can be reliably predicted using magnetic resonance imaging, single photon emission computed tomography or positron emission tomography , ECG asssessment is easy to perform, and non invasive. The most predictive electrocardiographic sign of old myocardial infarction is the presence of pathological Q-waves, but the Q-waves however are not reliable because it does not represent the involved myocardial segments and further there is now an increasing trend of non Q wave infarctions and in some inferior wall infarctions Q waves tend to disappear. Selvester QRS score has shown to be superior to various other scoring systems like minnesota score, novacode, and cardiac infarction injury score in estimating the infarct size .This scoring system has also proven to be useful for predicting recovery of LV function after acute MI, and also it gives maximum information regarding the prognosis. Thus MODIFIED SELVESTER QRS scoring system can be a very effective clinical tool for physicians. Even Q waves as small as 20 msec in some leads and 30msec in other leads of a standard ECG are rarely present in normal controls. Both intra- and interobserver agreements are acceptable.

ROLE OF ST SEGMENT RESOLUTION IN MI

- Rapid ways are required to estimate the effectiveness of reperfusion with respect to clinical grounds and also in clinical trials. The ST

segment resolution has recently gained lot of importance in this perspective. ST segment monitoring and resolution of ST segment as a simple means of predicting reperfusion in patients receiving reperfusion therapy for acute ST elevation myocardial infarction, is now being used to a large extent in clinical practice and in many research studies.

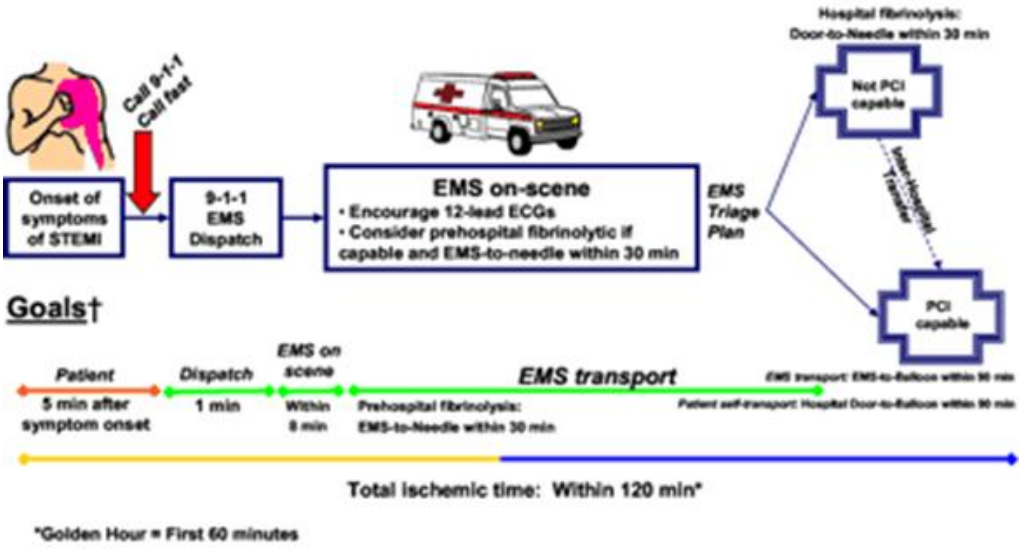
[10]The ST-segment resolution has gone a long way in assessing the chances of reperfusion in the absence of coronary angiogram. When compared to TIMI flow ST segment resolution is better in predicting the outcome of patients undergoing primary angioplasty. Thus ST-segment resolution 60–90 minutes after thrombolysis is an excellent marker of successful myocardial reperfusion.

- The efficacy of thrombolytic agents have been assessed using the Thrombolysis in Myocardial Infarction trial flow grade classification (TIMI). This classification estimates the coronary blood flow in the infarct-related artery after thrombolysis. Various factors seem to influence TIMI flow grade after fibrinolysis, these include hemodynamics, coronary anatomy, amount of residual thrombus, and other cellular factors.

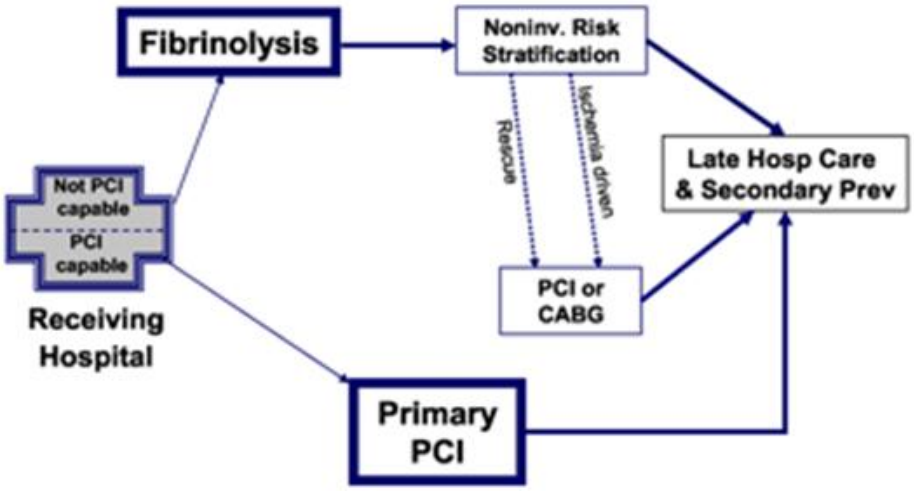
- TIMI 0 flow - No antegrade flow beyond a coronary occlusion
- TIMI 1 flow - Faint antegrade coronary flow beyond the occlusion, filling of the coronary bed distal to the occlusion is incomplete.
- TIMI 2 flow - Delayed or sluggish antegrade flow with complete filling of the territory distal to the occlusion.
- TIMI 3 flow - Normal flow with complete filling of the distal coronary bed

Numerous clinical trials have predicted that early resolution of ST segment in MI patients is associated with a high infarct-related artery patency, smaller size of the infarct, better left ventricular ejection fraction, and lower death rates at one, six months and at six years. Till today, many studies have evaluated the prognostic value of ST segment resolution as early as 90 minutes and up to 4 hours after fibrinolysis and established it to be a reliable bedside marker of prompt reperfusion of the infarcted artery. ST-segment resolution (STR) is a well-established and simple tool for assessing the efficacy of reperfusion therapy in myocardial infarction. An incomplete (<50%) STR is a recognized marker of failed thrombolysis and a suitable recruitment criterion for rescue angioplasty.

Panel A

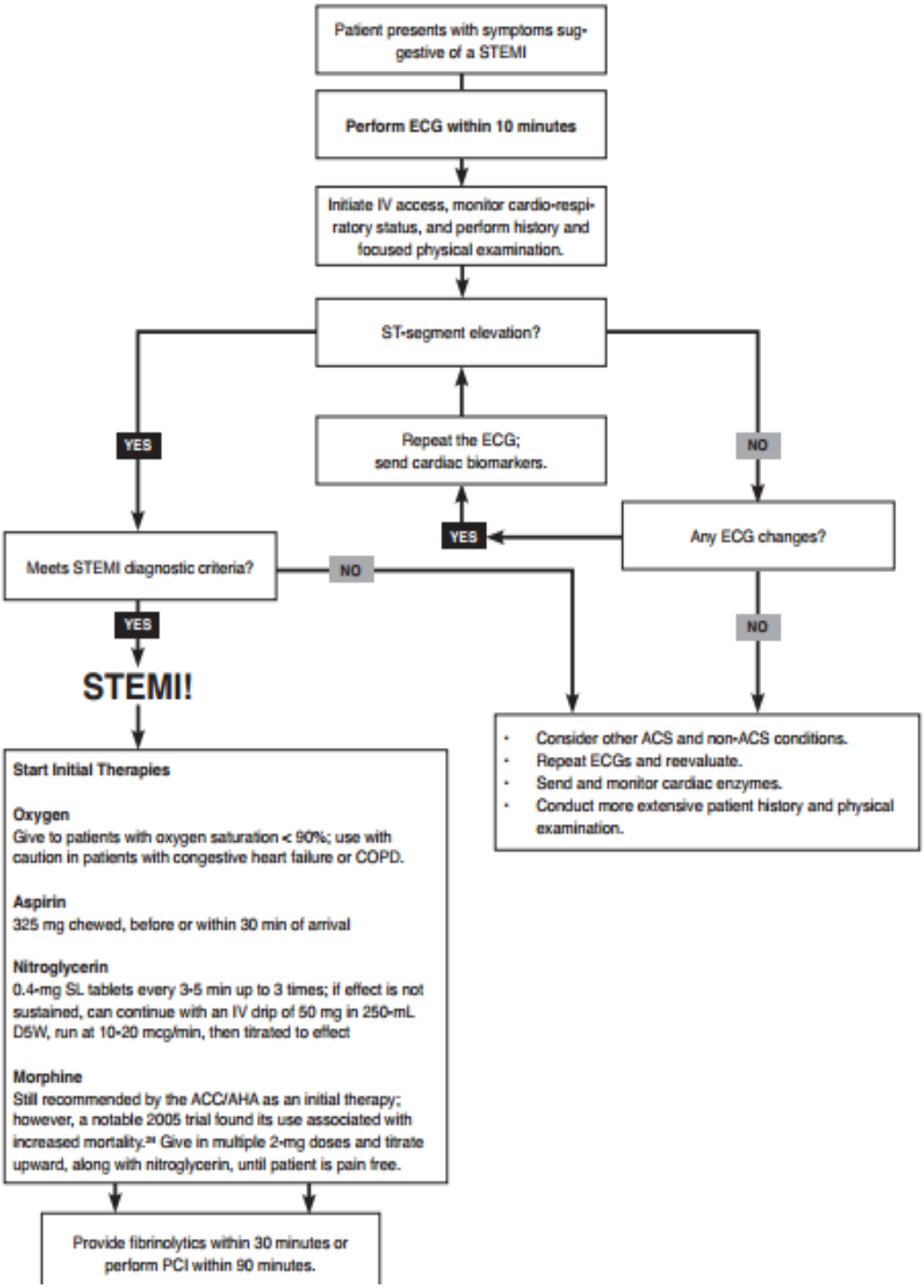


Panel B



DIAGNOSIS AND MANAGEMENT OF MI

Figure 3. Pathway For Diagnosis Of ST-Segment Elevation Myocardial Infarction



Risk stratification IN MI

Patients of ACS have variable prognosis. At one end of spectrum are young patients with new onset angina, no ECG changes, no elevated biomarkers and no hemodynamic instability. These patients are managed pharmacologically and they should undergo non invasive testing (TMT, stress echocardiography) after 10 days of symptom onset. At the other end are with history of recurrent / rest angina, fresh ECG changes, elevated biomarkers and, haemodynamically unstable patients who need early invasive strategy in the form of PCI.

The GRACE model

- Advanced age
- Killip class
- Systolic blood pressure
- ST-segment deviation
- Cardiac arrest during presentation
- Serum creatinine level
- Elevation of initial cardiac biomarkers
- Heart rate

It has the best predictive accuracy for death or MI at 1 year.

TIMI RISK SCORE

- Age > 65 years
- Presence of more than 3 risk factors for CAD
- Prior coronary stenosis $\geq 50\%$
- Presence of ST- segment deviation on admission ECG
- More than 2 episodes of angina within past 24 hours
- Prior use of aspirin in past 7 days
- Elevated cardiac markers

One point is given when risk factor is present and zero points if absent ; with a total of 7 points being possible . Low risk patients (TIMI 0 or 1) may be observed in a observation unit. If the patient remains free of chest pain, has normal cardiac enzymes, a non invasive stress test should be performed for further risk stratification. Patients should be negative for cardiac enzymes prior to stress testing. Intermediate or high risk patients should be taken to the cardiac care unit and should undergo non invasive stress testing or coronary angiography based on their clinical course and risk profile. Patients with a TIMI score of 0/1 has an incidence of 4.7% and those with a score of 6/7 has 40.9% ,of death, new or recurrent MI or recurrent ischemia requiring revascularisation. It is essential to determine the prognosis of patients with MI as it is a valuable

tool for the practitioners to assess the risks and benefits of potential therapies.

THROMBOLYTIC AGENTS:

FIRST GENERATION :

Streptokinase

Urokinase

SECOND GENERATION :

Recombinant tissue plasminogen activator (r- t PA, alteplase, duteplase), anisoylated plasminogen streptokinase activator complex (APSAC, anistreplase)

THIRD GENERATION :

Vampire bat salivary plasminogen activator,

Reteplase

TNK – Tpa

Lanoteplase(n-PA)

Tenecteplase

Staphylokinase

Recombinant glycosylated plasminogen activator

THROMBOLYTICS DRUGS UNDER DEVELOPMENT:

Antibody targeting thrombolytic agents

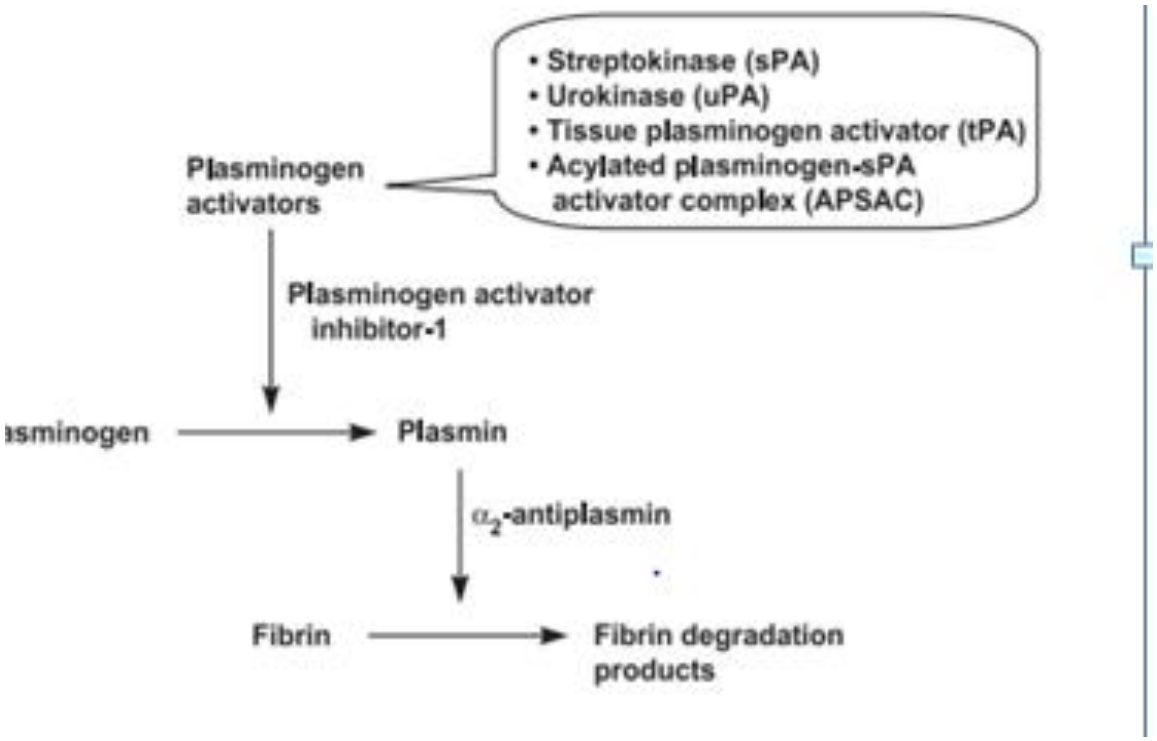
Polyethylene glycol coupled thrombolytic agents

Mutants and variants of plasminogen activator

Recombinant chimeric plasminogen activator

STATUS OF STREPTOKINASE IN DEVELOPING NATIONS

Streptokinase is the most widely used thrombolytic agent in developing nations like India.[14] Because the cost of t-PA is ten times higher when compared to streptokinase, the latter continues to be the fibrinolytic of choice in many developing nations.[15] It has been proved in various studies that Streptokinase is as efficacious as other fibrin specific agents in decreasing mortality.



- THROMBOLYTIC THERAPY IN ACUTE MI
- It has been proved beyond doubt that[5] early thrombolysis reduces mortality by 20-50%. This is achieved by reperfusion of the ischaemic myocardium which leads to limitation of the infarct size by 15-30%. Thrombolytics lead to bleeding in 0.5% of the population, however in several large trials the risk of bleeding was similar in thrombolytic & placebo group.
- The therapeutic goals in acute myocardial infarction(AMI) are to retard coagulation and platelet function, reopen the affected coronary artery and achieve the greatest possible degree of myocardial reperfusion in the shortest possible time[4]. Clinical approaches usually

include a variable combination of thrombolysis, angioplasty, anticoagulation, platelet inhibition and adrenergic blockade.'

As access to primary angioplasty is often limited, thrombolytic drugs are the most powerful agents currently available for reversing coronary arterial occlusion in the majority of patients. STREPTOKINASE: Streptokinase (STREPTASE) is a 47,000-dalton protein produced by b-hemolytic streptococci. It has no intrinsic enzymatic activity, but it forms a stable, noncovalent 1:1 complex with plasminogen. This produces a conformational change that exposes the active site on plasminogen that cleaves arginine 560 on free plasminogen to form free plasmin.

- **INDICATIONS FOR THROMBOLYSIS**
  - Early presentations (3 hours or less from symptom onset and delay to invasive strategy)
  - Invasive strategy is not an option
    Catheterization laboratory occupied / Not available
    Vascular access difficulties
    Lack of access to a skilled PCI laboratory
  - Delay to invasive strategy
  - Prolonged transport
  - (Door to balloon) – (Door to Needle) time is grater than 1 hour
  - Medical contact to balloon or door to balloon time is greater than 90 minutes.

- **Absolute contraindications** include:

- Those with Haemorrhagic stroke or stroke of unknown origin at any time. History of Ischaemic stroke in preceding 6 months. CNS trauma or neoplasms . Recent history major trauma/surgery/head injury (within preceding 3 weeks).Gastrointestinal bleeding within the last month ,history of known bleeding disorder, aortic dissection and Non-compressible punctures (e.g. liver biopsy, lumbar puncture)

- **Relative contraindications** are:

  - Transient ischaemic attack in preceding 6 months
  - Oral anticoagulant therapy
  - Pregnancy or within 1 week post-partum
  - Refractory hypertension (SBP >180 mmHg and/or DBP >110mmHg)
  - Advanced liver disease
  - Infective endocarditis
  - Active peptic ulcer; and
  - Refractory resuscitation

COMPLICATIONS OF STREPTOKINASE:

Skin rashes, fever, anaphylaxis are the allergic manifestations that occur in 1–2% of patients following streptokinase use. However hypotension is the most common complication of streptokinase that usually responds to volume expansion. Due to of potential of developing antibodies, patients who were previously treated with streptokinase should not receive an alternate fibrinolytic drug.

- The main aim of thrombolysis is to establish flow in the infarct related artery without delay[2]. Achievement of reperfusion within half an hour of MI can abort myocardial infarction. Reperfusion within half an hour to two hours can damage the myocardial tissue to a greater extent, and thrombolytic therapy given within this time frame may reduce mortality to the extent of 48%. Four fibrinolytic agents which are approved for STEMI are streptokinase, alteplase (tPA), reteplase, and tenecteplase [3]

COMPARISON OF FIBRINOLYTIC AGENTS FOR TREATMENT OF STEMI

Characteristic	Streptokinase	Alteplase	Reteplase	Tenecteplase
Dose	1.5 MU (over 30 to 60 min)	Up to 100 mg (over 90 min)	10 U (over 2 min) X 2 (30 min apart)	30–50 mg
Administration	Infusion	Infusion and bolus	Bolus (two)	Bolus
Weight-based dosing	No	Yes	No	Yes
Antigenic	Yes	No	No	No
Allergic reactions	Yes	No	No	No
Patency rate* (approx.)	50% to 55%	75%	80% to 83%	75% to 83%
Rate of TIMI grade 3 blood flow (approx.)	30% to 32%	50% to 54%	60%	60% to 63%
Fibrin specificity	No	Yes (++)	Yes (+)	Yes (+++)
Cost per recommended dose				

USEFULNESS OF STREPTOKINASE IN MI

The GISSI trial observations proved that earlier admission to coronary care unit and administration of streptokinase was associated with better chances of recovery. The study establishes the usefulness of streptokinase in MI. GISSI trial was succeded by numerous other clinical trials that strongly supported the use of streptokinase in MI patients. Following this lot of studies focussed on the choice of thrombolytic agent in AMI. 22 Large multicenter trials like GUSTO, GISSI -2 and ISIS-3 compared the efficacy of tissue plasminogen activator (t-PA) with that of

streptokinase. GUSTO trial found that there was no significant difference in mortality rates at the end of 30 days. GISSI-2 trial also reported similar mortality rates at the end of 6 months for patients randomized to receive t-PA or streptokinase. In addition, ISIS-3 also confirmed the fact that there was no major differences in mortality rates in those treated with streptokinase or t-PA.

EFFECTS OF STREPTOKINASE ON LV FUNCTION

[3]Intravenous streptokinase preserves left ventricular function in patients with acute myocardial infarction. This benefit includes favourable effects on the function of regions remote from the site of infarction. Thus intravenous streptokinase administered within 3 h after the onset of AMI preserves global left ventricular function in anterior AMI over a period of at least 7 months. Intravenous streptokinase improves regional myocardial function within the infarct zone as well as in remote areas.

- **SURVIVAL BENEFIT**

[12]ISIS-2 trial clearly establishes the fact that early survival advantage produced by fibrinolytic therapy in acute myocardial infarction lasts for many years after treatment . The survival benefits of fibrinolytic therapy lasts for at least 10 years after treatment.

- **THROMBOLYTIC THERAPY IN ELDERLY PATIENTS WITH MI :**

Advanced age is the most important risk factor predictive of mortality in AMI. Although thrombolytic therapy has increased since 1990 s, it is still underused in elderly patients. In patients 65 – 74 years of age, thrombolytic therapy has the greatest margin of benefit in absolute risk reduction. Despite the increased risk of bleeding in patients older than 75 years, the absolute net benefit is striking, with 18 lives saved per1000 patients treated. To combat the risk of haemorrhage, direct percutaneous revascularisation procedure may be considered in this age group.

- **ADJUVANT PERCUTANEOUS TRANSLUMINAL CORONARY ANGIOPLASTY:**

Studies have shown that immediate PTCA, may be superior to streptokinase in terms of recurrent ischaemia, reinfarction, and stroke rates as well as in patients with cardiogenic shock. The 4% risk of intracerebral haemorrhage in elderly patients receiving thrombolytic therapy can be greatly reduced or eliminated with PTCA, and insertion of stent may be an added advantage of angioplasty.

Because the efficacy of angioplasty depends more on operator skill and availability of suitable facilities and support personnel than does thrombolytic therapy and because of the significant delay in starting the procedure, PTCA cannot replace conventional thrombolytic agents for most patients. it has been suggested, however that thrombolytics therapy should be given in reduced dosage, even in pre hospital setting, and followed by PTCA in the hospital.

- **PREDICTORS OF FAILED THROMBOLYSIS**

[24]About 25-50% of patients fail to achieve successful reperfusion and these patients have poor prognosis. Since alternative modes of reperfusion are available, it is important to identify them. Late presentation is an important risk factor for failed thrombolysis in AMI. Persistence of chest pain, hyperglycemia and non-resolution of reciprocal ST depression are significantly associated with failed thrombolysis.

FUTURE CONSIDERATIONS OF THROMBOLYTICS

Despite several randomised trials proving that early thrombolytic therapy in patients with AMI reduces the mortality rate by approximately 30% and that reperfusion therapy provides better results when administered in the first 60 – 90 mins after symptom onset, the median time from symptom to thrombolytic therapy is 2.5 hours, and the door to

thrombolytic injection is still more than 50 mins. Measures to reduce this period will improve outcomes. Another approach to improving the results of thrombolysis, regardless of timing, is to inhibit clot stabilization and thereby promote thrombolytic potential.Blocking factor XIII-a mediated reactions in a controlled and selective manner that does not interfere with the primary clotting time may prevent a significant portion of the clot from progressing to the fully stabilised state. This may also enhance clot lysis. Another possible approach is monoclonal antibody directed against the thrombin cleaving site of factor XIII, which will prevent its activation by thrombin. Factor XIIIa catalysed covalent attachment of á2-plasmin inhibitor to fibrin contributes significantly to lytic resistance, and this may be blocked by an antibody against it. It has been shown to promote clot lysis both in vitro and in animal models.Such inhibitors of clot stabilisation may facilitate thrombolysis with much lower doses of plasminogen activators than are currently used with reduced risk of haemorrhage.

AIMS AND OBJECTIVES

To estimate whether Selvester QRS scoring would reliably predict resolution of ST segment in patients with first acute ST segment elevation myocardial infarction receiving fibrinolytic therapy with the drug streptokinase.

MATERIALS AND METHODS

The study was conducted on 62 patients admitted in the intensive coronary care unit of Government Rajaji Hospital, Madurai. Approval from the hospital ethical committee was obtained.

STUDY DESIGN:

The study was a cohort study conducted for a period of one year from March 2012 to August 2012.

Inclusion criteria:

- Patients with first acute STEMI in the age group of 30-80 years presenting within 24 hours from symptom onset, eligible for reperfusion therapy (presenting within 12 hours of symptom onset or presenting thereafter with persistent symptoms) were included in the study.
- The diagnosis of STEMI was based on ECG findings of ST segment elevation >1mm in atleast two contiguous leads in a patient presenting with typical history of angina and with elevated CPK MB.

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Exclusion criteria:

1. Patients with bundle branch block, paced rhythm, left fascicular block.
2. Ecg signs of ventricular hypertrophy.
3. Patients with cardiogenic shock.

Blood samples were collected for estimation of CPK MB, fasting lipid profile, complete hemogram, blood sugar, blood urea and creatinine.

DEFINITION OF RISK FACTORS

The presence of hypertension was defined as systolic BP > 140mm Hg and diastolic BP >90 mmHg. The presence of diabetes was defined as fasting plasma glucose >126 mg/dl and two hour glucose > 200 mg/dl. Dyslipidemia was defined as LDL cholesterol >100 mg/dl, TGL>150 mg/dl, HDL<40 mg/dl in men and <50 mg/dl in women.

METHOD:

All patients in the study received fibrinolytic therapy in the form of streptokinase by intravenous infusion, at a dose of 1,50,000 U over 30 – 60 mins. 12 lead ECG was taken for all patients from which the following was estimated:

1. QRS score was calculated according to modified Selvester QRS scoring system which incorporated 37 criteria all together generating 29 points. Score of > 4 in STE1 was considered to indicate non resolution of ST segment.

2. ST segment elevation was measured 20 ms after the J point. The height (in mm) of ST segment elevations was measured in leads I, avL and V1 through V6 for anterior infarctions and in leads II,III, aVF, for inferior infarctions. The sum of all measured ST segment elevations was expressed as STE1.

   Resting ECG was repeated for all patients 90 mins after the initiation of fibrinolytic therapy, and the sum of ST segment elevations were estimated and described as STE2.

3. The difference between ST elevation in the first(resting) and 90 mins ECG was calculated and expressed as the sum of ST segment resolution (∑STR) . Patients were grouped into those with {∑STR ≥ 50% of STE1} resolution group and those with {∑STR< 50% of STE1} non resolution group.

TABLE 1: BASE LINE CHARACTERISTICS OF WHOLE STUDY COHORT AND THE TWO STUDY GROUPS WITH RESPECT TO ST SEGMENT RESOLUTION

	WHOLE COHORT n = 62	RESOLUTION GROUP n = 32	NON RESOLUTION GROUP n =30	p value
AGE	56.23±14.2	50.75±11.82	62.07±14.26	0.001
MALE	44(71%)	24(54.5%)	20(45.5%)	0.47
FEMALE	18(29%)	8(44.4%)	10(55.6%)	
SMOKING	32(51.6%)	19(59.4%)	13(40.6%)	0.207
ALCOHOL	31(50%)	19(61.3%)	12(38.7%)	0.127
HYPERTENSION	26(41.9%)	13(50%)	13(50%)	0.829
DIABETES	25(40.3%)	8(32%)	17(68%)	0.011
CARDIAC FAILURE	15(24.2%)	2(13.3%)	13(86.7%)	0.001
ANT WALL MI	39(62.9%)	17(43.6%)	22(56.4%)	0.1
INF WALL MI	23(37.1%)	15(65.2%)	8(34.8%)	0.1
DYSLIPIDEMIA	40(64.5%)	19(47.5%)	21(52.5%)	0.38

TABLE 2: BASE LINE CHARACTERISTICS OF WHOLE STUDY COHORT AND THE TWO STUDY GROUPS WITH RESPECT TO QRS SCORE.

	WHOLE COHORT	QRS <4	QRS>4	p value
AGE	56.23±14.2	50.88±13.37	62.31±12.65	0.001
SMOKING	32(51.6%)	19(59.4%)	13(40.6%)	0.316
ALCOHOL	31(50%)	20(64.5%)	11(35.5%)	0.075
HYPERTENSION	26(41.9%)	9(34.6%)	17(65.4%)	0.013
DIABETES	25(40.3%)	7(28%)	18(72%)	0.001
CARDIAC FAILURE	15(24.2%)	4(26.7%)	11(73.3%)	0.018
ANT WALL MI	39(62.9%)	20(51.3%)	11(48.7%)	0.69
INF WALL MI	23(37.1%)	13(56.5%)	10(43.5%)	0.69
DYSLIPIDEMIA	40(64.5%)	20(50%)	20 (50%)	0.49

TABLE 3: ELECTROCARDIOGRAPHIC DATA OF THE OVERALL COHORT AND THE TWO STUDY GROUPS

	WHOLE COHORT n= 62	RESOLUTION GROUP n=32	NON RESOLUTION GROUP n= 30	p value
QRS SCORE	4.81±3.23	2.94±1.44	6.8±3.45	0.0001
STE 1	33.56±18.35	30.66±14.58	36.67±21.49	0.206
∑ STR	14.89±9.76	20±9.78	9.43±6.20	0.001
EJECTION FRACTION	39.13±7.77	43.84±4.82	34.10±7.17	0.0001

TABLE : 4

ELECTROCARDIOGRAPHIC DATA OF THE OVERALL COHORT AND THE TWO STUDY GROUPS

	WHOLE COHORT N = 62	QRS SCORE < 4	QRS SCORE > 4	p value
STE 1	33.56±18.35	30.95±15.38	36.52±21.12	0.238
∑STR	14.89±9.76	18.33±10.24	10.97±6.72	0.002
EJECTION FRACTION	39.13±7.77	42.8±5.06	34.93±8.25	0.001

Statistical analysis:

Analysis was performed with SPSS VERSION 17.0 statistical package. All continuous variables were presented as mean ±standard deviation if they were normally distributed. Differences in the normally distributed variables were assessed using the *t*-test and the paired *t*-test for dependent variable. Comparisons between the two individual groups were performed using the unpaired *t*-test (parametric). Pearson's correlation coefficient test was performed to study the correlation between the QRS score and the ∑STR. All tests were two-sided and a probability value of $p < 0.05$ was considered statistically significant.

RESULTS:

A total of 60 consecutive patients with first event of acute STEMI who received fibrinolytic therapy were enrolled in the study. The baseline characteristics of the whole cohort, and the two study groups, are represented in Table 1 (in relation to ST segment resolution) and Table 2 (in relation to QRS score). The mean age of the whole cohort was 56.23±14.2 with 44(71%) being males and 18(29%) being females. As compared to the resolution group, patients in the non-resolution group were older (62.07±14.26 vs 50.75 ± 11.82 respectively, $p < 0.05$), and QRS score [Table 2] was high in older population (62.31±12.65 vs 50.88±13.37 respectively, p value of 0.001).Sex did not have any significance to the ST segment resolution (p value 0.42) and the QRS score. Smoking(p value 0.207,p value 0.316) and alcohol (p value 0.127,p value 0.075) did not have significance in relation to the ST segment resolution and QRS score respectively, whereas when compared to resolution group, patients in the non resolution group were diabetics{17(68%) vs 8(32%) respectively p value0.011 } and QRS score was higher in diabetics { 18 (72%) vs 7 (28%) respectively, p value 0.001}. Congestive cardiac failure was higher in the non resolution group 13(86.7%) when compared to the resolution group 2(13.3%), p value 0.001, similarly QRS score was high in patients with CCF (73.3%)when

compared to non CCF patients(38.3%), with a statistical significance of 0.018. Hypertension (p value 0.829) did not have significance with respect to ST segment resolution, however hypertension was prevalent in patients with QRS > 4, p value 0.013. Type of MI (anterior wall or inferior wall) and dyslipidemia did not achieve significance in relation to the ST segment resolution (pvalue 0.1, p value 0.382) and QRS score (0.49,0.69,) respectively. Table 3 shows the electrocardiographic data of the overall cohort as well as the two study groups, the mean QRS score was less in the ST segment resolution group when compared to the ST segment non-resolution group (2.94± 1.44 *vs* 6.8 ± 3.45) respectively, p< .0001).There was a stastically significant negative association between QRS score and ∑STR with a correlation coefficient r^2 = 0.1044 as shown in fig 1.

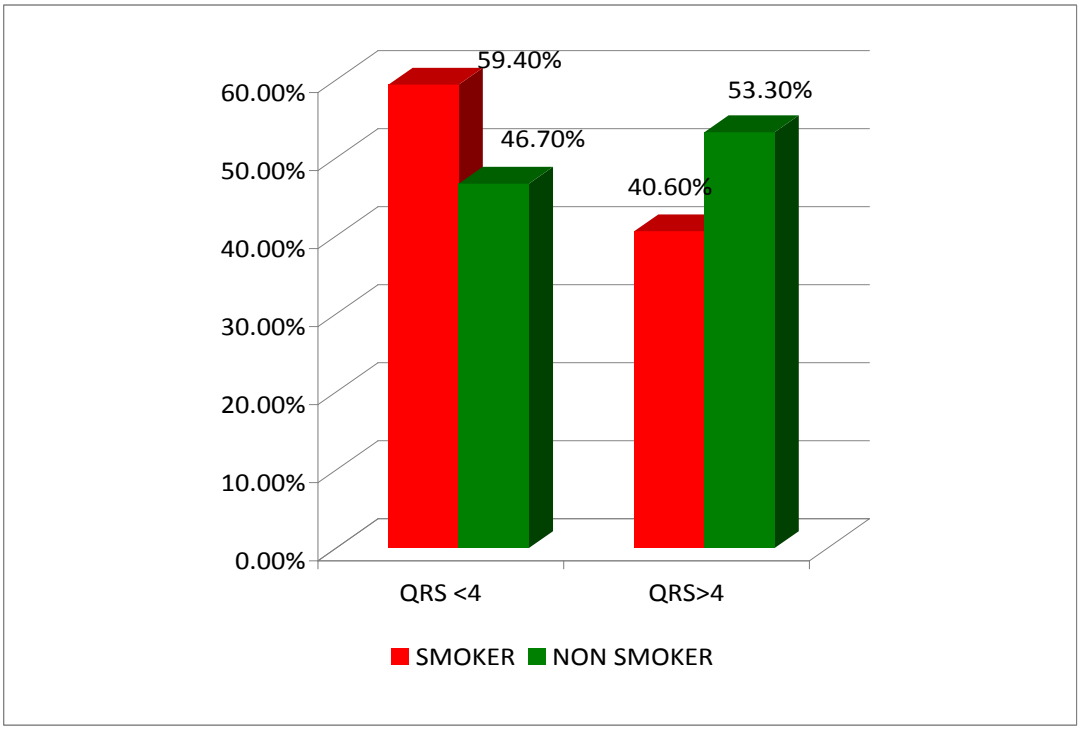
There was also a significant negative correlation between QRS score and ejection fraction with a p value of .001.[Table 4].

Table – 5 EFFECT OF SMOKING ON QRS SCORE AND ST SEGMENT RESOLUTION

	QRS <4	QRS>4	p VALUE
SMOKER	59.40%	40.60%	0.316
NON SMOKER	46.70%	53.30%	

	RESOLUTION NON RESOLUTION	NON RESOLUTION	p VALUE
SMOKER	59.40%	40.60%	
NON SMOKER	43.30%	56.70%	0.207

There is no significant association between smoking and QRS score and ST segment resolution.


60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
59.40%
46.70%
40.60%
53.30%
QRS <4
QRS>4
SMOKER
NON SMOKER

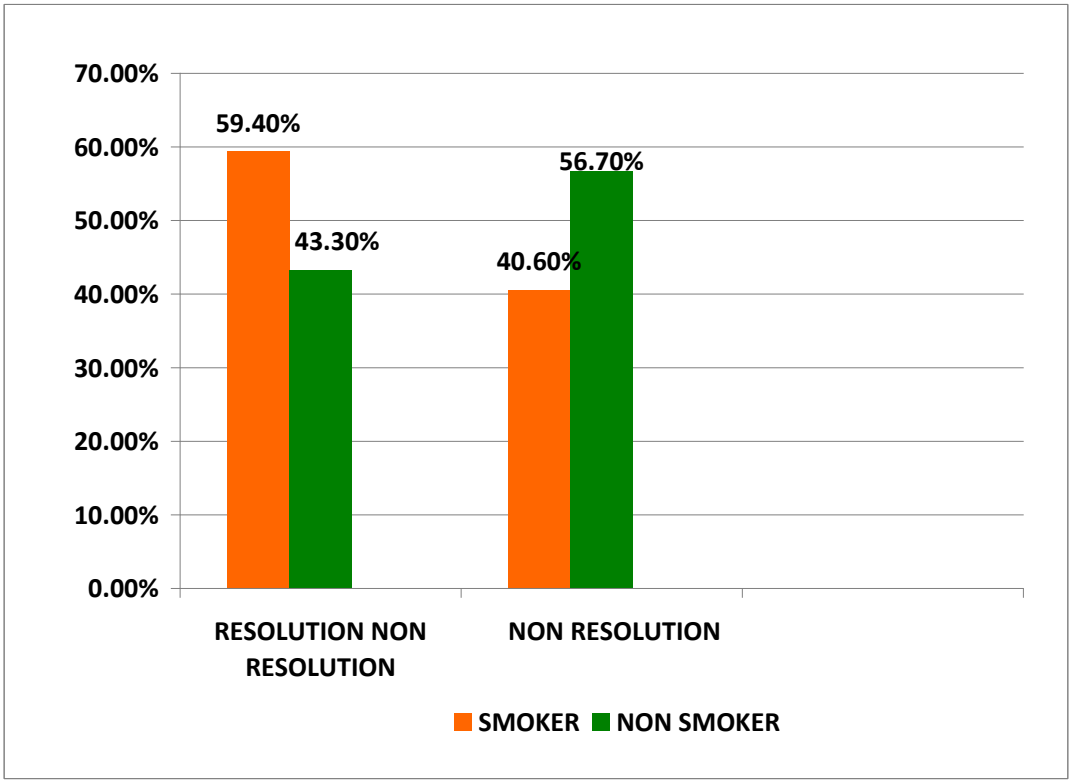

70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
59.40%
43.30%
40.60%
56.70%
RESOLUTION NON RESOLUTION
NON RESOLUTION
SMOKER
NON SMOKER

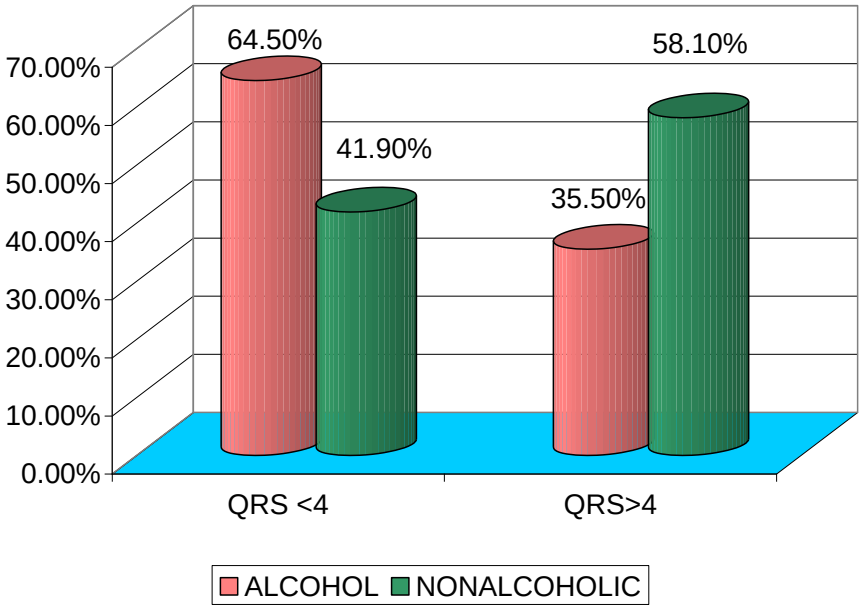
Table - 6

EFFECT OF ALCOHOL ON QRS SCORE AND ST SEGMENT RESOLUTION

	QRS <4	QRS>4	p VALUE
ALCOHOL	64.50%	35.50%	0.075
NONALCOHOLIC	41.90%	58.10%	

	RESOLUTION	NON RESOLUTION	p VALUE
ALCOHOLIC	61.3%	38.7%	0.127
NON ALCOHOLIC	41.90%	58.10%	

There is no significant association between alcohol and QRS score and ST segment resolution.


64.50%
58.10%
41.90%
35.50%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
QRS <4
QRS>4
ALCOHOL
NONALCOHOLIC

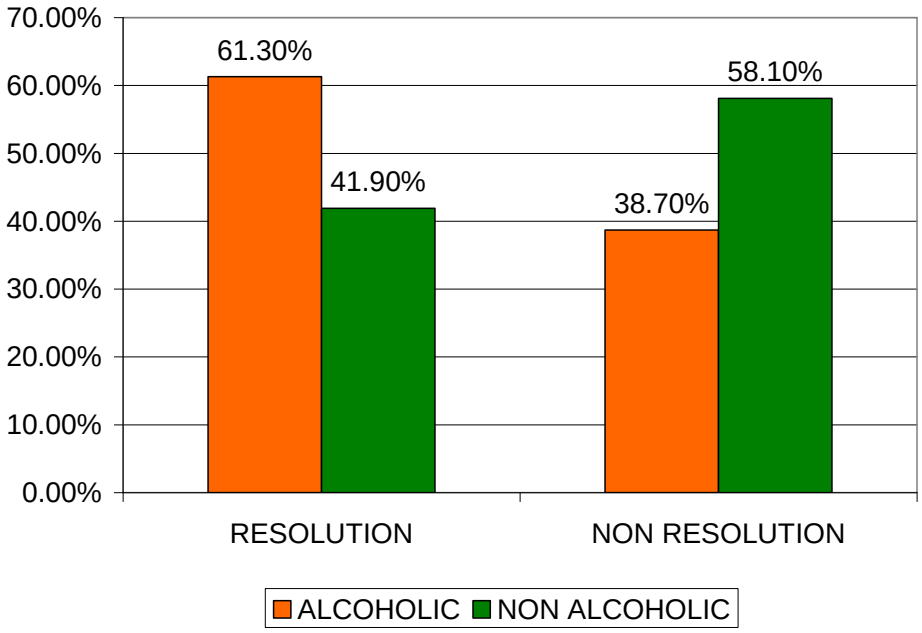

70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
61.30%
41.90%
38.70%
58.10%
RESOLUTION
NON RESOLUTION
ALCOHOLIC
NON ALCOHOLIC

Table - 7

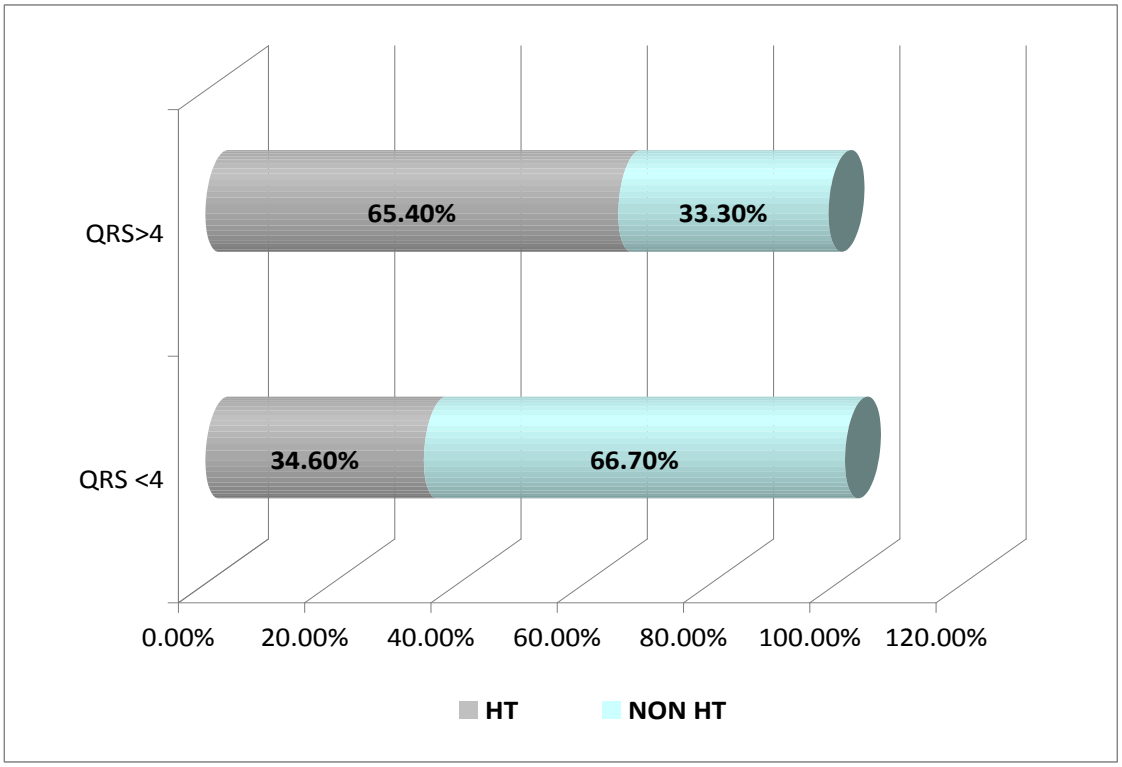
Effect of hypertension on QRS score and ST segment resolution

	QRS <4	QRS>4	p value
Hypertensives	34.60%	65.40%	0.013
Non hypertensives	66.70%	33.30%	

	RESOLUTION	NON RESOLUTION	p value
Hypertensives	50%	50%	0.829
Non hypertensives	52.80%	47.20%	

There is a significant association between hypertension and QRS score (p value 0.013), however there is no significant association between

hypertension and ST segment resolution.



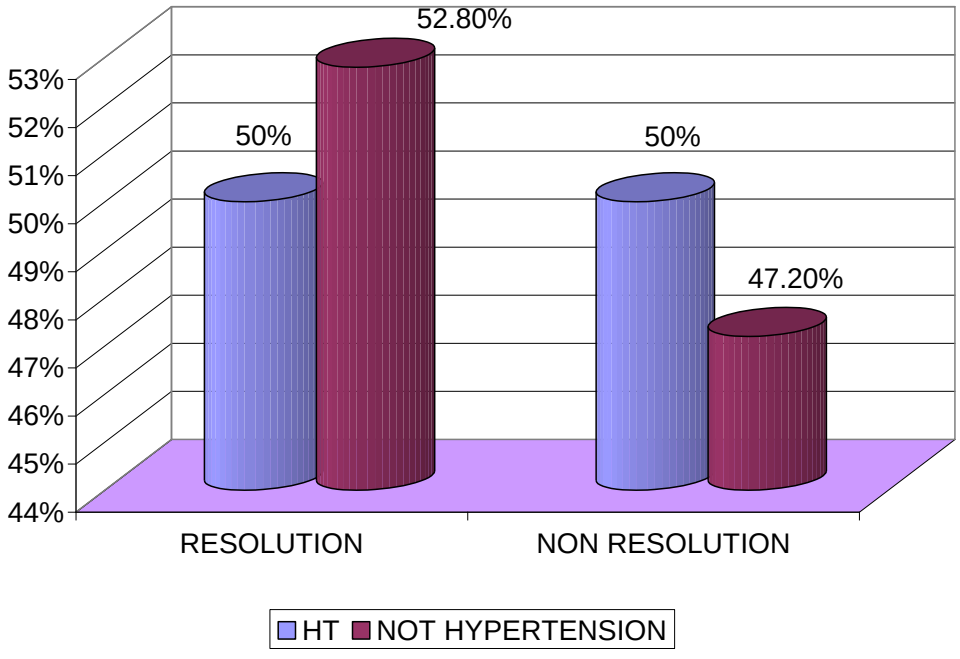


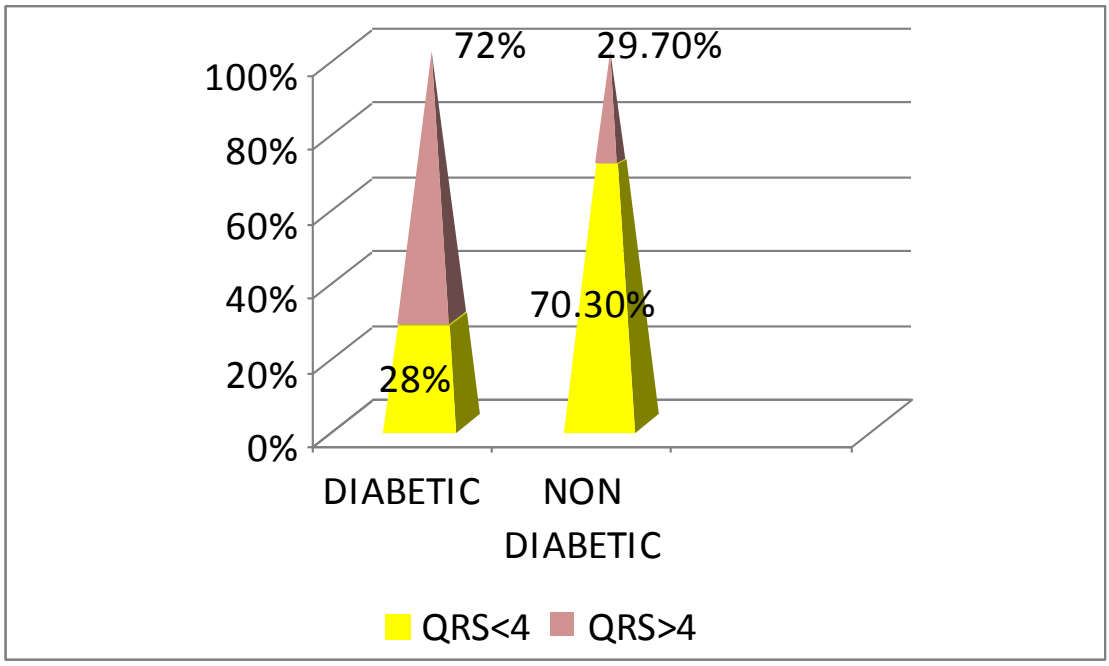
Table – 8

Effect of Diabetes on QRS score and ST segment resolution

	QRS<4	QRS>4	p VALUE
DIABETIC	28%	72%	0.001
NON DIABETIC	70.30%	29.70%	

	RESOLUTION	NON RESOLUTION	p VALUE
DIABETIC	32%	68%	0.011
NON DIABETIC	64.90%	35.10%	

There is a significant association between diabetes and QRS score (p value 0.001) and ST segment resolution (p value 0.011)


100%
80%
60%
40%
20%
0%
72%
29.70%
28%
70.30%
DIABETIC
NON DIABETIC
QRS<4
QRS>4

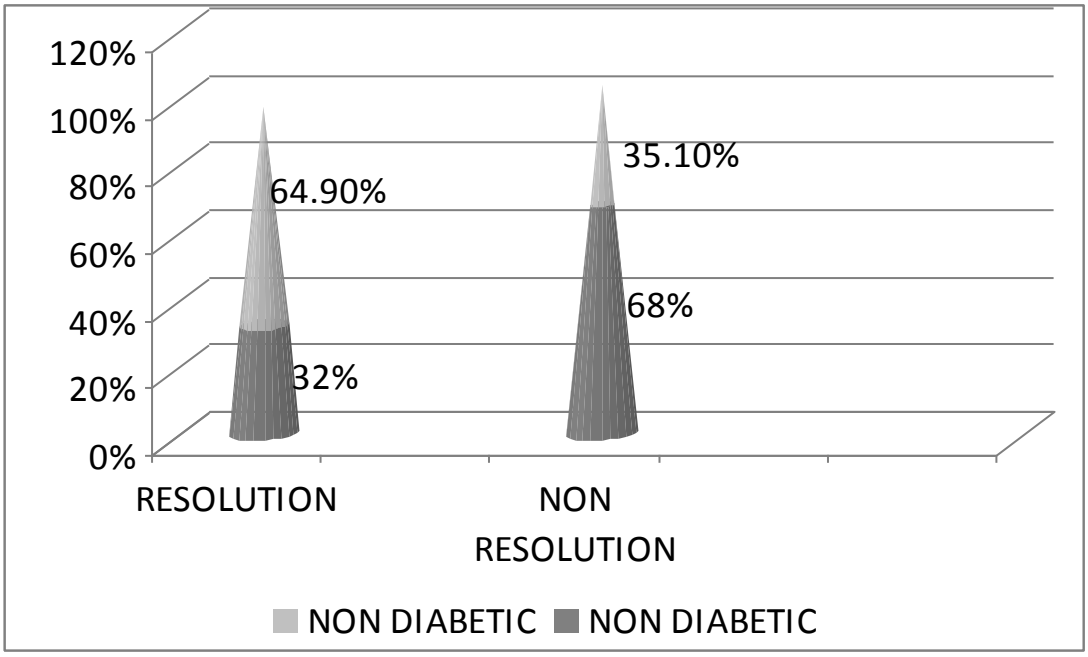

120%
100%
80%
60%
40%
20%
0%
64.90%
35.10%
32%
68%
RESOLUTION
NON RESOLUTION
NON DIABETIC
NON DIABETIC

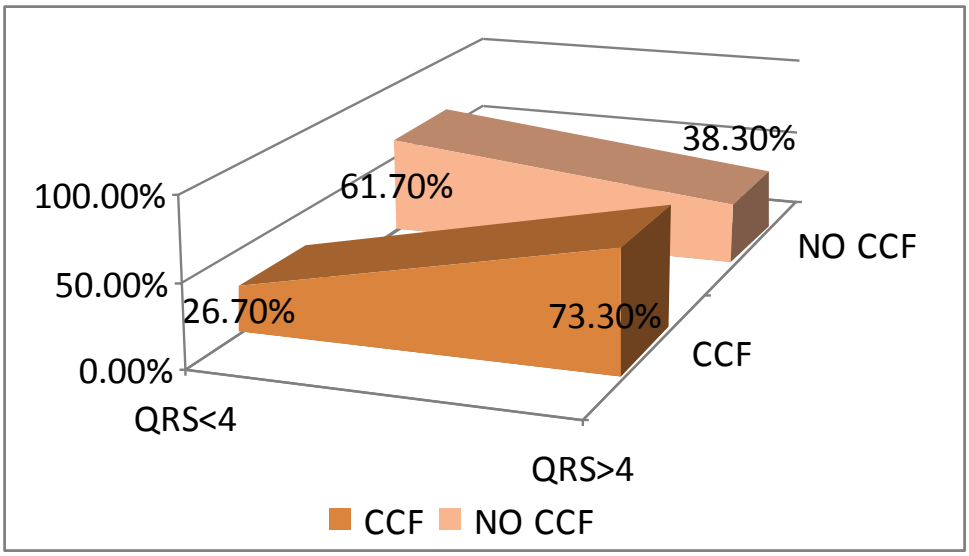
Table - 9

EFFECT OF CCF ON QRS score and ST segment resolution

	QRS < 4	QRS > 4	p VALUE
CCF	26.70%	73.30%	0.018
NO CCF	61.70%	38.30%	

	RESOLUTION	NON RESOLUTION	p VALUE
CCF	13.30%	86.70%	0.001
NO CCF	63.80%	36.20%	

There is a significant association between CCF and QRS score (p value 0.018) and ST segment resolution (p value 0.001).


100.00%
50.00%
0.00%
61.70%
38.30%
26.70%
73.30%
QRS<4
QRS>4
NO CCF
CCF
CCF
NO CCF

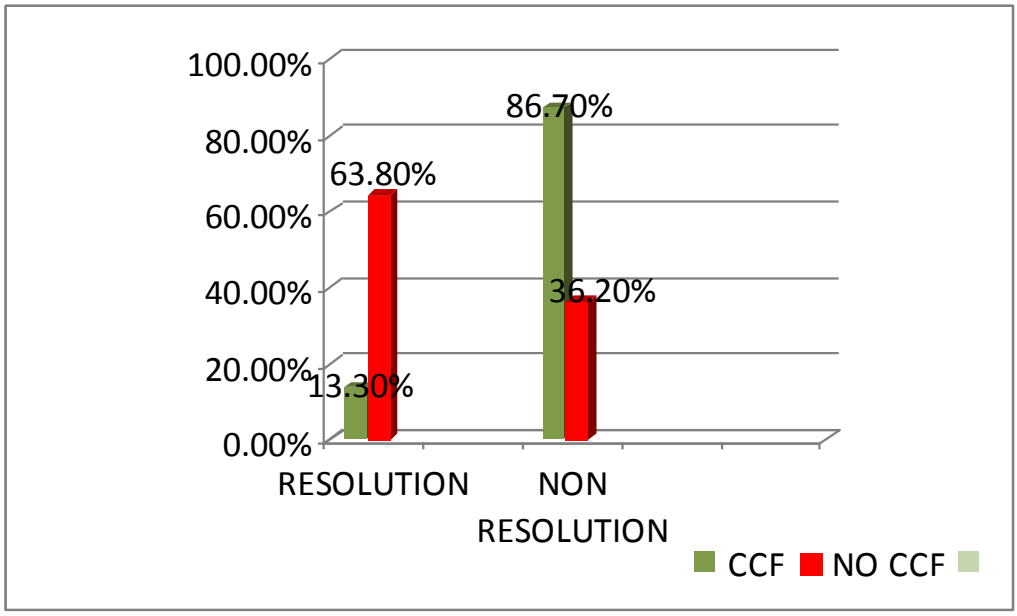

100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
63.80%
13.30%
86.70%
36.20%
RESOLUTION
NON RESOLUTION
CCF
NO CCF

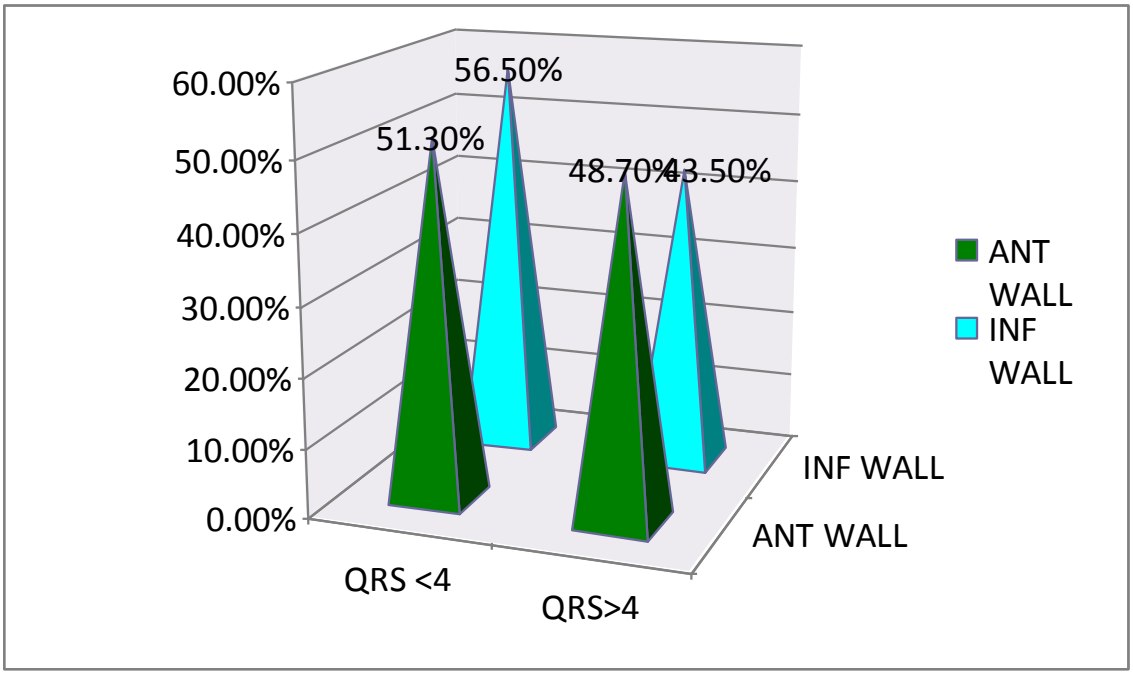
Table - 10

Effect of type of MI and QRS SCORE and ST segment resolution

TYPE OF MI	QRS < 4	QRS > 4	p VALUE
ANT WALL	51.30%	48.70%	0.69
INF WALL	56.50%	43.50%	

TYPE OF MI	RESOLUTION	NON RESOLUTION	p VALUE
ANT MI	43.60%	056.40%	0.1
INF MI	65.20%	34.80%	

There was no significant association between the type of MI (Anterior or inferior wall) with QRS score and ST segment resolution.



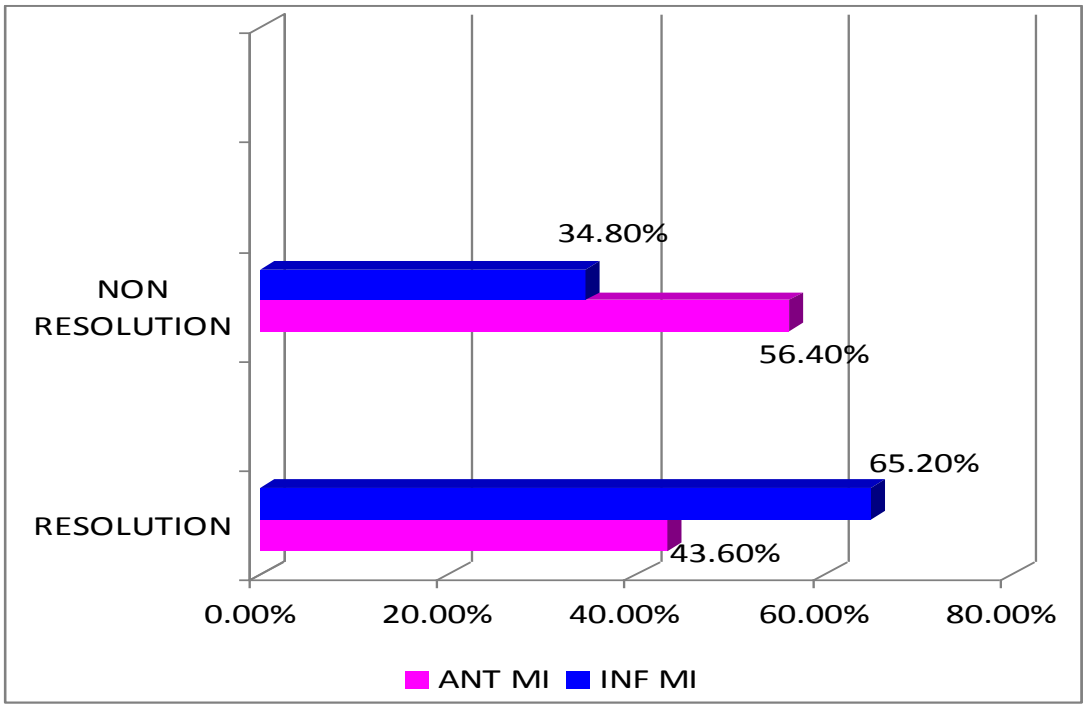


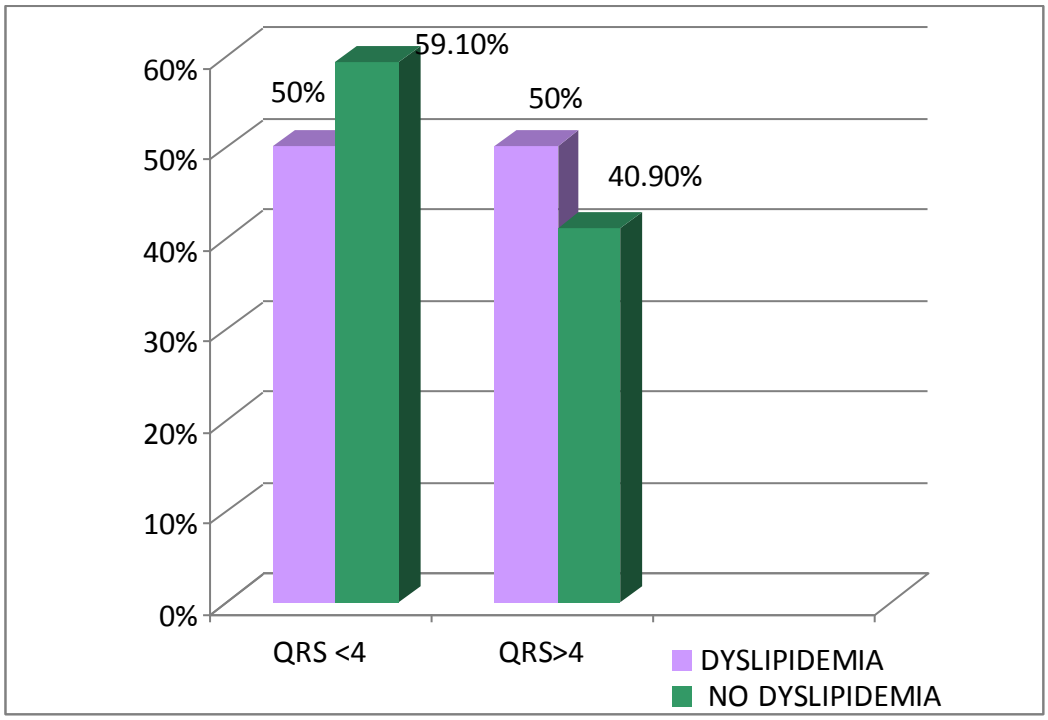
Table - 11

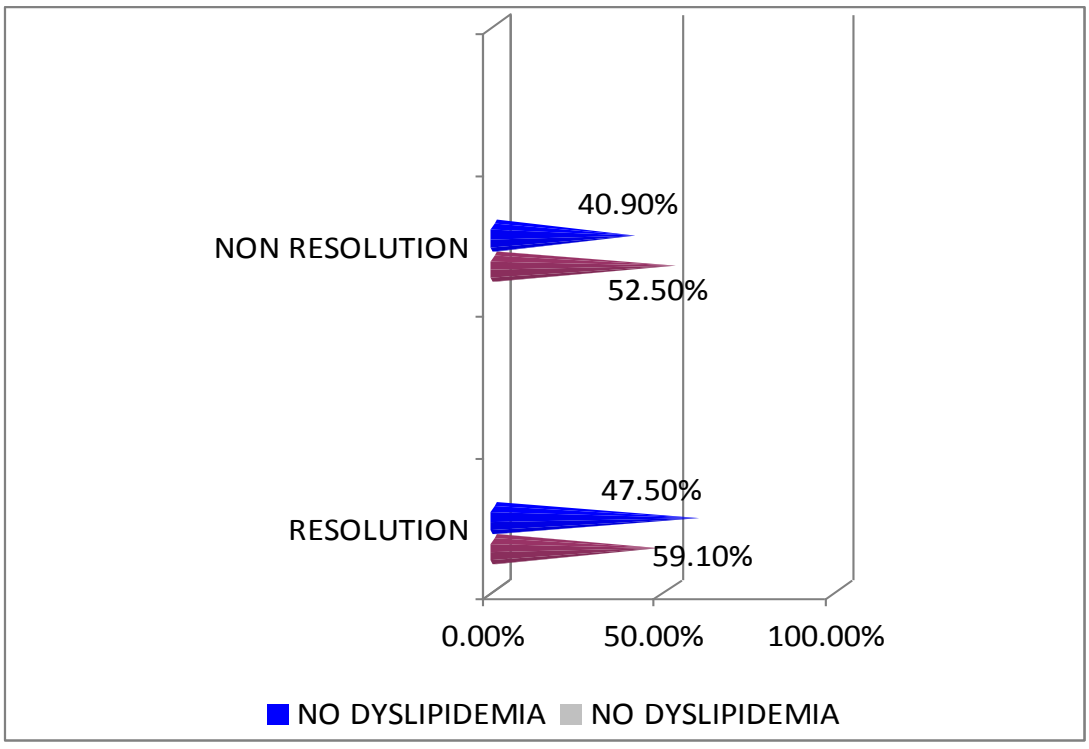
Effect of Dyslipidemia on QRS score and ST segment resolution

	QRS < 4	QRS > 4	p VALUE
DYSLIPIDEMIA	50%	50%	0.49
NO DYSLIPIDEMIA	59.10%	40.90%	

	RESSOLUTION	NON RESOLUTION	p VALUE
DYSLIPIDEMIA	47.50%	52.50%	0.382
NO DYSLIPIDEMIA	59.10%	40.90%	

There is no association between dyslipidemia and QRS score and ST segment resolution





DISCUSSION

Patients with AMI arrive at our hospital relatively rapidly due to its central location and most of the patients could obtain maximum benefit of thrombolytic therapy because streptokinase (SK) is provided by government free of cost. Varied modes of reperfusion therapy for Myocardial Infarction have been developed. But till date the most relevant treatment options are: Streptokinase (1.5 MU over 1 Hour) reteplase (2 boluses of 10 MU), and alteplase (tissue plasminogen activator, t-PA, 100 mg over 1.5 hour) and immediate angioplasty. When compared to angioplasty, streptokinase is cheap and easily available. We used SK due to cost effectiveness. Treatment of acute STEMI with thrombolytic therapy showed greater mortality reduction. Various clinical trials have proved beyond doubt that treatment with streptokinase reduces mortality and it is now well accepted as the mainstay of revascularisation options for patients with acute myocardial infarction.

The relability of ST segment nonresolution in predicting mortality has been extensively studied in many thrombolytic trials, ultimately proving beyond doubt that patients with acute MI who have ST segment non resolution are at risk of persistent infarct-related artery occlusion, larger infarct size , CCF and increased risk of death .On the

other hand, it was established that complete resolution of the ST segment resolution is a powerful tool for predicting flow in the infarct-related artery and preserved myocardial tissue perfusion. Selvester QRS scoring system was originally developed to predict 'electrocardiographically' the size of infarct in a well-established infarction; we sought to employ it (in a simplified form) in our study to quantify the QRS complexes during the early stage of an ongoing infarction process. In this way, we hypothesized that we could have a measure of 'how advanced the infarction process is'. We adopted the '< 50%' ST segment resolution as a cut-off level to predict failed reperfusion. The current study demonstrated that a 'simplified form' of the Selvester QRS score can reliably identify patients with acute STEMI who would achieve successful ST segment resolution after receiving fibrinolytic therapy. In these patients, value of > 4 of the simplified QRS score could best identify those who would have inadequate ST segment resolution after this therapy. The importance of this study is that it offers a chance at avoiding unnecessary thrombolysis in patients who present beyond the time window of benefit from fibrinolytic therapy (more than 12 h after symptom onset) who sometimes have persistent symptoms. In these patients, fibrinolytic therapy might still have a probable, though doubtful, role. Thus it seems appealing to identify those who are more likely to benefit from fibrinolysis in this

patient category. A simple evaluation of the width and amplitude of QRS complexes in the admission ECG recordings (and hence calculation of the QRS score) would help in this stratification. In this way, one can avoid giving fibrinolytic therapy to patients who are less likely to benefit from it and restrict it to only those who are more likely to benefit from it. The other major benefit of this study is that 'silent' acute myocardial infarction can be incidentally discovered in ECG recordings of patients presenting with symptoms other than chest pain, especially in diabetics, elderly and patients who develop infarction under general anaesthesia. In these patients, it is often really a tough task to delineate precisely the time of onset of infarction, and consequently whether the patient still lies within the time window for thrombolysis. In this situation, estimation of the QRS score could reliably offer an opportunity to recognize patients who are more likely to benefit from fibrinolytic regimens. Furthermore, even among patients presenting within the time window of thrombolysis, some have unusually increased risk of bleeding (as in elderly patients). In these patients, finding a high QRS score (at or above the cut-off value of 4) would be a compelling factor against giving a fibrinolytic regimen. Diabetics had a higher QRS score and non resolution of STsegment, for hyperglycemia predisposes to failed thrombolysis[24]. Unsurprisingly heart failure and left ventricular dysfunction was higher in the non ST segment

resolution group. Iwakura et al [25]noted that patients with no reflow as evidenced by myocardial contrast echocardiography, had a significantly higher Killip class on hospital admission than those with evidence of reflow. Insufficient myocardial perfusion at tissue level would lead to loss of more contractile units, that would translate into poor contractile function and pump failure.

CONCLUSION

1. It was found that as age advances non resolution of ST segment is higher and also the QRS scores are high.
2. ST segment non resolution and QRS scores were high in diabetics.
3. Sex, smoking, alcohol had no effect on ST segment resolution and QRS score.
4. Although hypertension had no effect on the ST segment resolution, hypertensives (without LVH) had a higher QRS score.
5. The type of MI and dyslipidemia did not correlate well with ST segment resolution and QRS score.
6. Patients with congestive heart failure and low ejection fraction were significantly associated with non resolution of ST segment and high QRS score.
7. There was a statistically significant negative correlation between QRS score and ∑STR.

Thus the Modified Selvester QRS score can reliably estimate the resolution of ST segment in patients with acute STEMI receiving fibrinolytic therapy. Using the cut-off mark of > 4, the QRS scoring system can estimate ST segment non resolution with a high sensitivity and an acceptable specificity.

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PROFORMA – CASE

Name : Age :

Sex :

Occupation :

Presenting complaints: Chest pain - Duration

Breathlessness

NYHA class

Other complaints

Past History :

Type 2 DM

Hypertension

CAD

Personal History : Smoker / Alcoholic

Family History of IHD :

General Examination : Pallor

Pedal edema

HR :

BP :

CVS ; S3 Gallop

Basal Crepitations

Type of MI : Anterior Wall

Extensive

Anterolateral

Anteroseptal

Inferior wall

With posterior wall and RVMI

KILLIP CLASS :

Median Delay :

Lab : Hb

CPK

Lipid profile

STE – 1 :

STE - 2 :

STR : > 50% Resolution

< 50% Resolution

QRS Score :

ECHO :

Leads	STE1	STE2
I		
II		
III		
aVR		
aVL		
aVF		
V1		
V2		
V3		
V4		
V5		
V6		
	Total =	**Total =**

□STR =

>50% Resolution

<50% Resolution

Lead	Duration (msec)		Amplitude ratios		Max points	
I	Q≥30	(1)	R/Q≤1	(1)	2	
II	Q≥40 Q≥30	(2) (1)			2	
aV_L	Q≥30	(1)	R/Q≤1	(1)	2	
aV_F	Q≥50 Q≥40 Q≥30	(3) (2) (1)	R/Q≤1 R/Q≤2	(2) (1)	5	
V_1	Any Q R≥50 R≥40	(1) (2) (1)	R/S≥1	(1)	4	
V_2	Any Q or R≤20 R≥60 R≥50	(1) (2) (1)	R/S≥1.5	(1)	4	
V_3	Any Q or R ≤ 30	(1)			1	
V_4	Q≥20	(1)	R/Q or R/S≤0.5 R/Q or R/S ≤1	(2) (1)	3	
V_5	Q≥30	(1)	R/Q or R/S ≤ 1 R/Q or R/S ≤ 2	(2) (1)	3	
V_6	Q≥30	(1)	R/Q or R/S ≤1 R/Q or R/S ≤3	(2) (1)	3	

S.No.	age	sex	duration	Diabetes	Hyperten	smoker	alcoholic	pallor	ccf	extensive	Ant lateral	ant septal	Inferior	inf post	killip	delay	cpk	lipid	ste1	ste2	>50%	<50%	QRS SCO	EF
1	50	M	4	NO	S	smoker	S	NO	S	S					2	4	244	S	52	21	S		2	37%
2	51	M	6	NO	NO	smoker	S	NO	NO	S					1	6	102	S	21	6	S		3	35%
3	34	M	1	NO	NO	smoker	N 0	NO	NO	S					1	1	166	N	73	45		S	7	35%
4	43	M	3	S	S	NO	S	NO	NO				S		1	3	184	S	7	4		S	6	49%
5	68	M	3	NO	S	smoker	S	NO	NO					S	1	3	791	S	15	6	S		4	42%
6	69	M	7	NO	NO	smoker	N 0	NO	NO	S					1	7	138	S	13	13		S	10	45%
7	65	F	12	NO	S	NO	N 0	NO	NO					S	1	12	321	S	11	8		S	7	32%
8	62	F	10	NO	NO	NO	N 0	S	S					S	2	10	624	S	10	8		S	2	45%
9	55	M	10	S	S	smoker	S	NO	NO					S	1	10	534	N	9	3	S		5	50%
10	30	M	1	NO	NO	smoker	S	NO	NO					S	1	1	321	N	32	11	S		3	46%
11	45	M	6	NO	NO	smoker	S	NO	S			S			2	6	556	S	15	13		S	6	40%
12	55	M	5	NO	NO	smoker	N 0	NO	S			S			2	4	123	N	16	5		S	3	34%
13	44	M	12	S	NO	NO	S	NO	S	S					2	12	345	S	28	20		S	5	35%
14	23	M	10	NO	NO	smoker	S	NO	S	S					2	10	221	N	15	11		S	3	42%
15	50	F	4	NO	NO	NO	N 0	S	NO					S	1	4	341	N	18	7	S		2	46%
16	80	F	8	S	S	NO	N 0	S	NO	S					1	8	211	S	29	7	S		2	44%
17	47	M	4	NO	S	smoker	N 0	NO	NO					S	1	4	113	N	14	6	S		5	37%
18	56	F	12	S	S	NO	N 0	S	S			S			2	12	435	N	35	13	S		6	33%
19	67	F	7	S	S	NO	N 0	NO	NO				S		1	7	245	S	46	16	S		3	42%
20	53	F	16	NO	S	NO	N 0	S	NO	S					1	16	340	S	34	30		S	7	25%
21	46	M	2	S	NO	smoker	S	NO	NO			S			I	2	667	S	32	12	S		2	50%
22	68	F	14	NO	S	NO	N 0	S	NO			S			1	14	134	N	56	40		S	2	42%

23	78	M	8	S	S	smoker	N 0	NO	NO		S				1	8	430	S	32	25		S	6	34%
24	45	M	12	NO	NO	smoker	alcoholic	NO	NO			S			1	12	221	N	58	20	S		3	41%
25	50	F	6	S	S	NO	N 0	S	NO					S	1	6	543	S	45	12	S		6	50%
26	62	F	16	S	NO	NO	N 0	S	S					S	2	16	444	S	18	12		S	12	23%
27	32	M	4	NO	NO	smoker	N 0	NO	NO				S		1	4	560	S	12	4	S		2	45%
28	78	M	12	S	S	smoker	alcoholic	NO	S		S				2	12	789	S	42	34		S	14	24%
29	39	M	5	NO	NO	NO	alcoholic	NO	NO				S		1	5	549	N	18	7	S		1	50%
30	80	F	8	S	S	NO	N 0	NO	S	S					2	8	967	S	67	54		S	12	28%
31	76	M	10	S	NO	smoker	alcoholic	NO	NO			S			1	10	328	S	65	54		S	10	23%
32	49	M	5	NO	NO	smoker	alcoholic	NO	NO	S					1	5	654	N	43	16	S		3	43%
33	36	M	3	NO	NO	smoker	alcoholic	NO	NO					S	1	3	566	S	16	6	S		2	45%
34	48	M	8	S	NO	smoker	alcoholic	NO	NO	S					1	8	454	N	49	36		S	3	38%
35	67	M	12	S	NO	smoker	N 0	NO	NO				S		1	12	123	S	56	38		S	6	40%
36	79	M	10	NO	S	smoker	alcoholic	NO	S	S					2	10	1020	S	68	56		S	14	32%
37	52	M	9	NO	S	smoker	alcoholic	NO	NO				S		1	9	898	N	18	7	S		6	45%
38	60	M	4	S	NO	NO	N 0	NO	NO	S					1	4	659	S	32	12	S		3	48%
39	55	M	7	NO	NO	smoker	N 0	NO	NO					S	1	7	774	S	17	6	S		2	40%
40	72	M	5	S	S	NO	N 0	NO	NO			S			1	5	899	S	56	23	S	S	3	38%
41	62	M	6	S	NO	NO	alcoholic	NO	NO				S		1	6	909	S	19	12		S	6	34%
42	44	M	7	NO	NO	NO	alcoholic	NO	NO		S				1	7	600	S	45	12	S		1	50%
43	38	F	4	NO	NO	NO	N 0	S	NO			S			1	4	453	S	24	10	S		2	36%
44	76	M	8	S	NO	NO	N 0	NO	NO		S				1	8	967	N	68	56		S	9	29%
45	54	M	16	NO	NO	smoker	alcoholic	NO	NO				S		1	16	1233	S	21	6	S		3	46%
46	62	M	5	S	NO	smoker	alcoholic	NO	NO	S					1	5	322	N	47	30		S	8	42%
47	35	M	3	S	hyperten	smoker	alcoholic	NO	NO					S	1	3	233	N	17	6	S		2	48%
48	63	M	13	NO	hyperten	smoker	alcoholic	S	S	S					2	13	990	N	49	29		S	5	32%

49	58	M	8	NO	NO	smoker	alcoholic	NO	NO			S			1	6	356	S	34	12	S		2	48%
50	67	M	2	S	NO	NO	N 0	NO	NO				S		1	2	777	N	24	19		S	5	41%
51	47	M	7	S	NO	smoker	alcoholic	NO	NO	S					1	7	1232	S	58	17	S		2	42%
52	32	M	2	NO	NO	NO	alcoholic	NO	NO					S	1	2	875	N	18	5	S		1	50%
53	63	F	10	S	S	NO	N 0	S	S		S				2	10	645	S	24	15		S	7	32%
54	80	M	5	S	S	NO	N 0	S	S	S					2	5	1231	S	68	54		S	10	23%
55	51	M	14	NO	NO	NO	alcoholic	NO	NO			S			1	14	342	S	26	17		S	2	32%
56	49	M	3	NO	NO	smoker	alcoholic	NO	NO			S			1	3	454	N	38	12	S		3	44%
57	69	F	6	NO	S	NO	N 0	S	NO				S		1	6	343	S	14	10		S	2	34%
58	57	F	12	S	S	NO	N 0	S	NO	S					1	12	876	S	43	15	S		3	45%
59	61	F	9	NO	S	NO	N 0	S	NO		S				1	9	232	S	24	10	S		5	42%
60	72	F	13	S	S	NO	N 0	S	S	S					2	13	534	S	54	45		S	8	26%
61	59	M	10	NO	NO	smoker	alcoholic	NO	NO	S					1	10	683	N	41	15	S		2	45%
62	68	F	8	S	NO	NO	N 0	S	NO		S				1	8	673	S	32	24		S	7	32%

ABBREVIATIONS

STEMI	-	ST ELEVATION MYOCARDIA INFARCTION
STE 1	-	SUM OF ST SEGMENT ELEVATION IN THE FIRST ECG
STE 2	-	SUM OF ST SEGMENT ELEVATION IN THE 90 MINS ECG
∑STR	-	DIFFERENCE BETWEEN STE 1 AND STE 2
FHS	-	FRANINGHAM HEART STUDY
SK	-	STREPTOKINASE
GUSTO	-	GLOBAL UTILIZATION OF STREPTOKINASE AND TISSUE PLASMINOGEN ACTIVATOR FOR OCCLUDED CORONARY ARTERIES
IRIS	-	INTERNATIONAL STUDY OF INFARCT SURVIVAL COLLABORATION GROUP
T PA	-	TISSUE PLASMINOGEN ACTIVATOR
GISSI	-	GRUPPO ITALINOPER SO STUDIO DELLA SOPRAVVIENZANCIL INFARCTO
ACC/AHA	-	AMERICAN COLLEGE OF CARDIOLOGY / AMERICAN HEART ASSOCIATION

Ref. No. 00216 /E4/3/2011

Govt.Rajaji Hospital,Madurai.20.
Dated: .01.2012

Institutional Review Board / Independent Ethics Committee.
Dr. A. Edwin Joe, M.D (FM), BL.,
Dean, Madurai Medical College & 2521021 (Secy)
Govt Rajaji Hospital, Madurai 625020.
Convenor
grhethicssecy @gmail.com.

Sub: Establishment-Govt. Rajaji Hospital, aMadurai-20-
Ethics committee-Meeting Agenda-communicated-regarding.

The next Ethics Committee meeting of the Govt. Rajaji Hospital, Madurai was held at 11.00 Am to 1.00Pm on 27.01.2012 at the Dean Chamber, Govt. Rajaji Hospital, Madurai. The following members of the committee have been attended the meeting.

1. Dr.N.Vijayasankaran,M.ch(Uro.) 094-430-58793 0452-2584397	Sr.Consultant Urologist Madurai Kidney Centre, Sivagangai Road,Madurai	Chairman
2. Dr.P.K. Muthu Kumarasamy, M.D., 9843050911	Professor & H.O.D of Medical, Oncology(Retired)	Member Secretary
3. Dr.T.Meena,MD 094-437-74875	Professor of Physiology, Madurai Medical College	Member
4. Dr. S. Thamilarasi, M.D (Pharmacol)	Professor of pharmacology	
5.Dr.Moses K.Daniel MD(Gen.Medicine) 098-421-56066	Professor of Medicine Madurai Medical College	Member
6.Dr.M.Gobinath,MS(Gen.Surgery) 097-871-50040	Professor of Surgery Madurai Medical College	Member
7.Dr.S. Dilshadh, MD(O&G)	Professor of OP&Gyn Madurai Medical College	Member
8.Dr.S. Vadivel Murugan., M.D, 097-871-50040	Professor of Medicine Madurai Medical College	Member
9.Shri.M.Sridher,B.sc.B.L. 099-949-07400	Advocate, 623-B.II.Floor,East II Cross, K.K.Nagar,Madurai.20.	Member
10.Shri.O.B.D.Bharat,B.sc., 094-437-14162	Businessman Plot No.588, K.K.Nagar,Madurai.20.	Member
11.Shri. S.sivakumar,M.A(Social) Mphil 093-444-84990	Sociologist, Plot No.51 F.F, K.K. Nagar, Madurai.	Member

Following Projects were approved by the committee

Sl. No	Name of P.G.	Course	Name of the Project	Remarks
1.	k. Ramya	PG M.D (gent med)	Sylvester ORS score in predicting ST seg resolution after fibrinolysis for AMI.	Approved

Please note that the investigator should adhere the following: She/He should get a detailed informed consent from the patients/participants and maintain Confidentially.

1. She/He should carry out the work without detrimental to regular activities as well as without extra expenditure to the institution to Government.
2. She/He should inform the institution Ethical Committee in case of any change of study procedure site and investigation or guide.
3. She/He should not deviate for the area of the work for which applied for Ethical clearance.
She/He should inform the IEC immediately, in case of any adverse events pr Serious adverse reactions.
4. She/he should abide to the rules and regulations of the institution.
5. She/He should complete the work within the specific period and apply for if any Extension of time is required She should apply for permission again and do the work.
6. She/He should submit the summary of the work to the Ethical Committee on Completion of the work.
7. She/He should not claim any funds from the institution while doing the word or on completion.
8. She/He should understand that the members of IEC have the right to monitor the work with prior intimation.

DEAN

To
All the above members and Head of the Departments concerned.
All the Applicants.

MODIFIED SELVESTER QRS SCORE IN PREDICTING SUCCESSFUL ST SEGMENT RESOLUTION IN PATIENTS WITH ACUTE MYOCARDIAL INFARCTION RECEIVING FIBRINOLYTIC THERAPY WITH STREPTOKINASE

DISSERTATION SUBMITTED FOR

DOCTOR OF MEDICINE

BRANCH - I (GENERAL MEDICINE)

MARCH 2013

THE TAMILNADU

DR.M.G.R.MEDICAL UNIVERSITY

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Assignment title	Medical
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Submission time	12-Dec-2012 02:20PM
Total words	12795

First 100 words of your submission

MODIFIED SELVESTER QRS SCORE IN PREDICTING SUCCESSFUL ST SEGMENT RESOLUTION IN PATIENTS WITH ACUTE MYOCARDIAL INFARCTION RECEIVING FIBRINOLYTIC THERAPY WITH STREPTOKINASE DISSERTATION SUBMITTED FOR DOCTOR OF MEDICINE BRANCH - I (GENERAL MEDICINE) MARCH 2013 THE TAMILNADU DR.M.G.R.MEDICAL UNIVERSITY CHENNAI 1 BONAFIDE CERTIFICATE This is to certify that the dissertation entitled "MODIFIED SELVESTER QRS SCORE IN PREDICTING SUCCESSFUL ST SEGMENT RESOLUTION IN PATIENTS WITH ACUTE MYOCARDIAL INFARCTION RECEIVING FIBRINOLYTIC THERAPY WITH STREPTOKINASE" submitted by Dr. K.RAMYA to the Tamil Nadu Dr. M.G.R. Medical University, Chennai in partial fulfillment of the requirement for the award of M.D...